B-4-L XC

CleanHarbors
ENVIRONMENTAL SERVICES, INC.

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Chicago, IL 60617
773.646.6202
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October 23, 2003

Ms. Joyce Munie
Illinois Environmental Protection Agency
Bureau of Land- #33
Permit Section
1021 North Grand Avenue East
PO Box 19276
Springfield, IL 62794-9276

Transmit via Federal Express #

RE: Completeness Notice of Deficiency for Clean Harbors Services, Inc. ILD000608471

Dear Ms. Munie

Clean Harbors Services, Inc. (CHSI) is submitting requested completeness deficiency responses per your letter dated July 3, 2003.

In order to clarify our response per each issue, we are responding in the same order as the issues raised in Attachment A of the July 3, 2003 letter.

CHSI is stating that no information from the April 19, 2003 application and this submittal is exempt from public disclosure.

Should you have any questions, please contact me at (773) 646-6202.

Sincerely,

James R. Laubsted
Facility Compliance Manager

Cc:
File

Clean Harbors Services, Inc.
11800 S. Stony Island Avenue
Chicago, IL 60617

EPA ID No. ILD000608471

RCRA Part B License
Request for Permit
October 17, 2003

Volume 6A
Appendices
D-50 through D-52

APPENDIX D-50

Manufacturer Information Concerning Stacking

Of Non-Metallic containers

APPENDIX D-51

Demonstration of Stacking Height and Pile Arrangement Meeting NFPA 30 Requirements

Container Stacking Compliance with NFPA 30

The following areas are utilized for container storage of flammable and combustible materials as defined by NFPA.

- Building 61 (Unit 61)
- Building 26 (Unit 26)
- Building 25 (Unit 25)
- Units R1/R2 (partially constructed)
- Building U (Unit U) (not yet constructed)
- Building 42 (Unit 42) (not yet constructed)
- Shredder Process Building (Unit 24) (not yet constructed)

The buildings are all protected by a foam based fire suppression system that complies with NFPA 11.

Per NFPA 30, these areas meet the definition of "Inside Liquid Storage Area".

NFPA 30: 4-4 Design, Construction and Operation of Inside Liquid Storage Areas
NFPA 30: 4-4.4.1 Where storage of liquids is protected, the protection shall meet the protection requirements of Section 4-8.
NFPA 30: 4-8.2 Where automatic sprinklers or low expansion foam-water sprinkler systems are used, the protection criteria of Tables 4-8.2(a) through 4-8.2(f) shall be followed for the applicable liquid class, container type and storage arrangement.

Per Table A-4.8.2(a) Storage Arrangements for Protected Palletized or solid Pile Storage of Liquids in Containers and Portable Tanks;

CHSI storage areas are defined as ground floor. Excerpts from the table are outlined below.

Class	**Maximum Storage Height (ft) Containers**	**Maximum Quantity per Pile (gal) Containers**
IA	5	3000
IB	6.5	5000
IC	6.5	5000
II	10	10000
III	20	15000

Building 61 has a maximum storage capacity of 160 drums (8800 gallons) stacked no higher than the height of a 55-gallon drum. The containers are stored in five rows of 1760 gallons each separated by aisles of four-feet.

Building 26 has a maximum storage capacity of 192 drums (10,560 gallons) stacked no higher than the height of a 55-gallon drum. The containers are stored in five rows (four of 1980 gallons, one of 2420 gallons each separated by aisles of four-feet. There is storage of four drums (220 gallons) in a cutoff room also.

Building 25 has storage of flammable materials in the south bay. This bay consists of a staging area of 40 drums (2200 gallons) stacked no higher than the height of a 55-gallon drum and a storage area of 144 drums (7920 gallons) stacked two high. The staging area includes two rows of twelve drums (660 gallons) each and one row of sixteen drums (880 gallons) with each row separated by four-feet. The storage area consists of three rows of 32 drums (1760 gallons) and one row of 48 drums (2640 gallons). CHSI limits the storage area height to five feet for Class 1A flammable liquids, and Class 1B and 1C flammable liquids in containers greater than five gallons.

Building U contains storage areas including flammables of six drums (330 gallons), organics of four drums (220 gallons) and five drums (275 gallons). The drums are stacked no higher than the height of a 55-gallon drum.

Building 42 includes the Westside Pad with a capacity of 24 drums (1320 gallons) single-stacked with one group of sixteen drums (880 gallons) and two groups of four drums (220 gallons). The large group is located more than five feet from the smaller groups. The building also includes 28 drums (1540 gallons) single-stacked.

Unit 24 includes sixteen drums (880 gallons) single-stacked on the conveyor and one drum (55 gallons).

The following areas are utilized for storage of flammable and combustible materials as defined by NFPA. Per NFPA 30, these areas meet the definition of "Outdoor Occupancy Classification".

- Units R1/R2

These areas are located outside under a canopy at the southdock in the facility.

Specific storage requirements for containers are found in Table 4-7 in NFPA 30. The maximum volume in an arrangement of containers (pile) shall not exceed the following:

i. 1,100 gallons for arrangements with one or more containers of waste which have a flash point below 73F and a boiling point below 100F.

ii. 2,200 gallons for arrangements with one or more containers of waste which have a flash point below 73F and a boiling point above 100F.

iii. 4,400 gallons for arrangements with one or more containers of waste which have a flash point at or above 73F and a boiling point below 100F.

iv. 8,800 gallons for arrangements with one or more containers of waste which have a flash point at or above 100F and a boiling point below 140F.

v. 22,000 gallons for arrangements which do not contain one or more containers of waste which have a flash point below 140F.

Units R1/R2 consist of two staging areas and three storage bays where drums are stacked no higher than the height of a 55-gallon drum. The east staging area contains four rows of twenty drums (1100 gallons) each separated by a five-foot aisle. 80 drums of solids may also be staged on the dumping dock. The west staging area contains five rows of sixteen drums (880 gallons) each separated by a five-foot aisle. The three storage bays are identical and each contain five rows split in halves of sixteen drums (880 gallons) each. Each row is separated by five-foot aisles and each row is separated in half by a five-foot aisle.

APPENDIX D-52

Compressed Gas Cylinder Program and Guidelines

Compressed Gas Activities

Clean Harbors of Chicago, Inc. is a hazardous waste treatment, storage, and disposal facility which manages and stores wastes which include compressed gases. These compressed gases are contained in cylinders, aerosol cans, and inhalers. Compressed gas wastes are managed and stored in the following units:

	Drawing #
Unit B	4218
Unit C	4218
Unit G1	4209 (2 of 2)
Unit Q	4210 (1 of 3)
Unit R1	4210 (1 of 3)
Unit R2	4210 (1 of 3)
Unit U	4211
Unit V	4234
Unit W	4244
Unit 15	4248
Unit 25	4210 (3 of 3)
Unit 26	4210 (2 of 3)
Unit 59	4247
Unit 61	4245
Unit 62	4246

Drawings of these units are included as Attachment 1.

Compressed gas wastes are broken down into two categories. Cylinders are handled by the Compressed Gas Cylinder Program and Guidelines included as Attachment 2. Inhalers (designed for human use) and aerosol cans (consumer products consisting of a propellant and product (paints, pesticides, etc.)) are handled as lab packs.

Preacceptance Procedures

Cylinders will be visually inspected in the field to determine if that material meets minimum qualifications for safe handling and transportation. This criteria includes evaluation of denting, corrosion, bulging, leaking conditions associated with the cylinder, and specifics of the compressed gas waste. The Cylinder Evaluation Form (CEF) is the document used during this evaluation. The CEF details the necessary information required to approve the waste for the facility. The CEF will be evaluated at the facility to determine approval of the cylinder for shipment to the facility. Detailed information on cylinder evaluation in the field is included in the Compressed Gas Cylinder Program and Guidelines.

Inhalers (intended for human use) and aerosols (consumer products) are comprised of known, unused commercial chemical products which are not mixed with other characteristic or listed hazardous wastes. These "special wastes" are handled as lab packs and are not subject to sampling or analyses as part of the prequalification process. Instead, Clean Harbors will rely on generator knowledge and use of product, container labeling, manufacturer information, MSDS's, EPA waste codes, and lab pack inventory review procedures to determine the suitability of the material for approval and acceptance.

The prequalification procedures are conducted by Clean Harbors personnel at the site of generation. During the waste identification and lab packing process, Clean Harbors personnel compare the EPA hazardous waste codes of the chemicals proposed for handling with the list of waste codes which appear on the facility's RCRA Part A form. Any waste code which does not appear on the Part A form is not authorized for acceptance and storage at the facility, and will not be allowed for shipment to the facility. In cases where a container is prepackaged by the generator, Clean Harbors will inspect the container to verify the accuracy of the packing slip and ensure that the proper waste packing techniques have been followed.

Waste compressed gases shipped to Clean Harbors must meet the following additional criteria:

1. All waste compressed gases must be accompanied by an accurate and complete Illinois hazardous waste manifest and Land Disposal Restriction form (if applicable);

2. A packing slip for each drum or a Cylinder Evaluation Form for each cylinder must accompany the hazardous waste manifest;

3. A packing slip or Cylinder Evaluation Form must be attached to the container or cylinder.

Receiving Procedures

Compressed gas wastes must be shipped according to DOT regulations. As the trucks transporting the compressed gas wastes arrive at the facility, they will be placed into transportation vehicle storage areas or container storage areas. "Special wastes" such as inhalers and aerosols are shipped as lab packs inside outer packaging. Lecture bottles, lecture spheres, or other cylinders not equipped with a protective cap should be packed upright in wooden boxes or other DOT approved packaging (pails, drums, etc.). The cylinders should be surrounded by vermiculite to prevent the valve from jarring against the container side.

Small, medium, or full-sized cylinders do not need to be overpacked into containers provided a valve cover is in place.

Even if the cylinder has a valve cap, the cylinders should be placed into appropriate sized containers (16, 30, or 55 gallon drums) surrounded with vermiculite as added protection. Cylinders may also be secured to the side of the trailer using two racket straps or laid on its side and strapped to a pallet.

Any boxes or drums containing compressed gas wastes should be located at the end of the truck near the rear door and secured with load locks. Full-size cylinders should also be loaded at the rear of the truck and properly secured.

Before a truck containing compressed gas wastes is entered, the plant lab pack chemist must review the paperwork. The paperwork will list the entire contents of the vehicle and act to indicate any possible hazardous situations to look for upon entering the truck. Trucks may be entered under level D protection unless there is any indication of a possibly dangerous atmosphere (i.e. fumes, stench, etc.). If an indication exists, the truck will be immediately evacuated. Notify the supervisor and emergency coordinator so the situation can be evaluated.

After confirmation that the contents of the truck do not present chemical hazards, the truck can be physically offloaded. Boxes may be moved by hand or fork lift. Containers, and cylinders on pallets should be moved by hand (small containers), fork lift or drum cart. All cylinders which are not containerized must be moved by a cylinder cart.

Incoming compressed gas wastes will be placed in the staging area for paperwork review procedures. After unloading from the truck, cylinders will be reinspected before being placed into storage. The inspection includes confirming the Cylinder Evaluation Form data and completing the Facility Cylinder Inspection Form (included as attachment 3). Inhalers and aerosols handled as lab packs will be checked against the packing slip (inventory). Based on a review of the packing slip or CEF, Clean Harbors will confirm that the compressed gas waste is authorized for storage and handling at the facility. If the waste material is deemed unacceptable, the generator will be notified and the wastes will be shipped back to the generator or to an alternate approved waste management facility.

Compressed gas wastes will be checked for manifest count, proper labeling and marking, and assigned a facility tracking number. The tracking number and the date received (to ensure compliance with the LDR 1-year storage limit) will be placed on the cylinder or container. The plant lab pack chemist will determine compatibility of the compressed gas waste with the appropriate storage bay from the CEF or packing slip utilizing chemical classification system based on 40 CFR 264 Appendix V.

Compressed gas wastes will not be subjected to conformance analyses but will rely on the stringent preacceptance review procedures.

Handling

Acceptable compressed gas wastes will be moved to the appropriate storage bay as determined by compatibility. Individual storage bays are separated by concrete curbs and ramps. Boxes may be moved by hand or fork lift. Containers and cylinders on pallets may be moved by hand (small containers), fork lift, or drum cart. All cylinders which are not containerized must be moved by a cylinder cart.

A. Manual Movement

Manual movement of boxes or containers will utilize the following procedure:

1. Wear proper safety equipment including safety shoes, apron or Tyvek suit, long sleeve shirt, hard hat, safety glasses and chemical resistant gloves.
2. Make sure box or container is appropriated sealed.
3. For boxes and containers weighing 20 pounds or less, carefully lift and move to appropriate location. For boxes or containers weighing 21 to 70 pounds, utilize a second person to carefully lift and move to the appropriate location.
4. For containers weighing greater than 70 pounds, the manual roll can be utilized.

Personnel are advised to take the following precautions during manual drum movements:

1. Make sure box or container is under control at all times.
2. If losing control, warn others in area; let go of container and stay clear.
3. Make sure hands and feet are free when setting down box or container.
4. Do not muscle container.

B. Two-Wheeled Carts

Two-wheeled carts may be used to move heavy containers or to move containers up an incline. In operating a two-wheeled cart, the following procedures are to be followed:

1. Wear proper safety equipment , including hard hat, safety shoes, safety glasses, chemical resistant gloves, long sleeve shirt, apron or tyvek suit.

2. Make sure container is properly sealed.

3. Place two-wheeled cart next to drum so tires are on bottom of drum chimes.

4. Place hook on two-wheeled cart on top of drum. Make sure it is secure.

5. Place foot on two-wheeled cart.

6. Pull handles toward you slowly until drum weight balanced over wheels.

7. Place drum down slowly.

Personnel are advised to take the following precautions while using a two-wheeled cart:

1. Never leave two-wheeled cart on a drum when not moving.

2. Never leave two-wheeled cart on ground. Replace in storage area.

C. Palletizing

All boxes and containers must be placed onto pallets prior to being placed into the storage bays. The procedures for palletizing containers are:

1. Wear proper safety equipment including hard hat, chemical resistant gloves, safety shoes, safety glasses, long sleeve shirt, and Tyvek suit or apron.

2. Make sure the pallet is in good condition.

3. Roll container to pallet so bottom chime is over middle of pallet.

4. Place container down.

5. Position body with firm stance.

6. Push up on drum near body until weight is on chime.

7. Spin on to pallet and in position.

8. Continue operation with other containers.

9. To remove containers from pallet, reverse process.

Boxes and small containers may be manually lifted and placed on the pallet.

Personnel are advised to take the following precautions during palletizing operations:

1. Watch feet and hands at all times to avoid other containers or dropping down.

2. If you lose control, let go of container, move clear and warn others in area.

D. Fork Lifts

The following procedures address the key points to be remembered in operating the fork lift in these areas, as well as throughout the facility.

The fork lift operator should always be aware of the nature and hazardous properties of the materials being handled. Because the compressed gas wastes will be known from the packing list or CEF, the trained operator will know immediately which wastes it should not be stored with.

When stacking containers, care must be taken as to not impale the container(s) with the fork lift blade(s) or otherwise damage the container.

E. Cylinder Cart

The following procedure is used when moving cylinders on the cylinder cart:

1. Unstrap cylinder from current location.

2. Tilt cylinder and carefully roll on to cart.

3. Secure cylinder to cart using strap.

4. Slowly wheel secured cylinder to area where to be stored/transported.

5. Unstrap cylinder.

6. Lift and tilt cylinder off of cart to new location.

7. Properly secure cylinder in new location.

Storage

Full-sized cylinders may be stored in a 4'x 4'x 6' metal cage. Cylinders must be stored upright and chained to the side of the cage. Full-sized cylinders may also be stored at in the chemically compatible bay, chained to the wall or fixed structure. Containerized compressed gas wastes (boxes, pails, drums) are stored on pallets in the rows where other containerized wastes are stored. The aisles between each row of pallets and between pallets and a wall are a minimum of two feet apart to provide adequate access for inspection. Containers shall be positioned such that the markings and labels are readable during inspections. Containers may be stacked provided that:

a. Only the same size or smaller containers are stacked on top of the containers beneath.

b. 55-gallon or larger containers are separated by a pallet or other dunnage to provide stability.

c. A pallet for stability for smaller size containers shall be used when the height of the stack exceeds 42 inches unless the containers are shrink wrapped. 55-gallon or larger containers may be stacked 2-high with a pallet under each container. Smaller containers may be stacked as long as the height of the stack does not exceed the height of two 55-gallon containers on pallets (i.e. 84 inches).

d. 55-gallon or larger containers may not be stacked in the flammable storage areas. Smaller containers may be stacked so long as the height of the stack does not exceed the height of one 55-gallon drum on a pallet (i.e. 42 inches).

All containers shall remain closed at all times except when waste is being added or removed. Cylinders shall remain closed at all times. Open-top drums must have covers, gaskets, and rings, and the covers must be tightly secured.

RCRA and NFPA Gas Cylinder Segregation Requirements state that incompatible gases must be stored 20 feet away from each other, or separated by a five foot high barrier of non-combustible materials having a fire resistance rating of at least one half hour. The following table summarizes the requirements:

Gas Hazard Category	Non-flam	Ox	Flam	Pyro	Toxic
Toxic	C	20 ft	20 ft	20 ft	---
Pyrophoric	C	20 ft	20 ft	---	20 ft
Flammable	C	20 ft	---	20 ft	20 ft
Oxidizing	C	---	20 ft	20 ft	20 ft
Non-flam	---	C	C	C	C

C=compatible

<u>Inspections</u>

Clean Harbors of Chicago, Inc. is required to perform inspections as part of its RCRA Part B Permit. Container storage areas and secondary containment structures are visually inspected on a daily basis. The daily inspections are documented on an inspection report. Compressed gas wastes in boxes, containers, or cylinders are stored and handled in these areas and are included in the inspections as are all waste stored in these areas. The Container Storage Area Inspection Schedule requires the following daily inspection:

ITEM	INSPECTION ELEMENT/TYPE OF PROBLEM
Container Storage Area	Check for evidence of spilled material on slab, ramps, drains, sumps
	Check for removal of absorbent materials and cleanup rags
	Check for, cracks and gaps in, or damage to, containment bases, sump and drains and coatings
	Check for erosion, uneven settlement, etc.
	Check for corrosion of grating over drains and sumps
Stored Containers	Check for containers being in good condition
	Check that containers are not open
	Check for proper placement
	Check adequacy of aisle space
	Check height of stacks
	Check storage capacity not exceeded
	Check for proper labeling
Container Loading/ Unloading Area	Check for damaged containers
	Check for evidence of spilled material on slab and ramps used

Container Loading/ Unloading Area (Continued)	Check for removal of used absorbent and cleaning materials
	Check for prompt container removal from receiving area
	Inspect grounding system equipment for operability

It should be noted that compressed gas wastes from off-site held on a truck in a transportation vehicle storage area for 10 days or less are not considered to be in storage (i.e. they would not have to meet the same aisle space and compatibility requirements as the other container storage units). However, trucks being loaded at the site are not considered to be in storage as long as this activity is conducted within ten days. These wastes held in a common secondary containment system or draining to a single sump shall meet the DOT segregation and compatibility requirements of 49 CFR Parts 171-179. **Compressed gas wastes held in a truck in a transportation vehicle storage area for more than 10 days must meet RCRA aisle space and compatibility requirements. These requirements apply to both the wastes on the truck and the area the trucks are parked.**

Training

Clean Harbors of Chicago, Inc. has a written personnel training plan designed to familiarize personnel with the properties and hazardous nature of the hazardous waste stored and handled at the facility, with the procedures to operate and maintain the facility in a safe manner, and with the procedures and equipment to be used in the event of an emergency at the facility. The required RCRA training includes many aspects associated with compressed gas wastes including the following:

1. Health and Safety Training/Awareness
2. Personnel Protection Equipment
3. DOT/RCRA Labeling and Manifesting
4. Clean Harbors Licenses, Permits, and Approvals
5. Contingency and SPCC Plan Training
6. Properties and Nature of Hazardous Waste
7. Waste Analysis Plan
8. Inspection Plan

9. Standard Operating Procedures

10. Decontamination Procedures

While these training sessions cover all types of waste accepted at the facility, they each specifically address compressed gas wastes also.

Clean Harbors also has other training sessions for specific topics including a compressed gas training module. This module includes training of the compressed gas cylinder program and guidelines and compressed gas activities. Each new employee involved with waste compressed gas handling activities at the facility will not be allowed to work with waste compressed gases without supervision until receiving the compressed gas training module and required RCRA training. In addition, those employees will have annual review training to review and reinforce previous training topics, and to instruct employees on new techniques, procedures, regulations, or other relevant topics.

Emergency Response Procedures

Clean Harbors of Chicago, Inc. has developed an approved contingency plan designed to minimize hazards to human health or the environment from fires, explosions, or unplanned, sudden, or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface waters. The actions described in this plan must be implemented immediately whenever such releases could threaten human health or the environment. This plan covers incidents associated with waste compressed gases including:

1. Implementation of the plan
2. Emergency response notifications
3. Identification of hazardous materials
4. Assessment of hazards
5. Control procedures
6. Prevention of recurrence
7. Storage of released material
8. Incompatible waste
9. Post emergency equipment maintenance
10. Emergency equipment

11. Coordination agreement requirements

12. Evacuation plan

13. Required reports

Clean Harbors of Chicago, Inc. has added a specialty emergency response company which deals with compressed gas incidents to the Contingency Plan.

Waste Compressed gases can include flammables, pyrophorics, asphyxiants, oxidizers, corrosives, toxics, and poisons. In the event of a fire, explosion, or a release involving waste compressed gases, the following response procedures should be followed:

1. Immediately notify the Emergency Coordinator.

2. Alert other personnel in adjacent areas to potential hazards.

3. Render assistance to personnel that might be involved in the emergency and remove them from further exposure or injury.

4. The Emergency Coordinator will, depending on the magnitude of the situation, call for local emergency assistance.

5. If evacuation of the facility is required, all plant operations are to immediately cease. All personnel are to quickly and calmly exit their workplace, evacuate the facility via the prescribed evacuation routes, and assemble in the designated emergency assembly area outside the main entrance to the facility.

6. Facility personnel should only attempt to handle fires or other emergencies in their incipient stage. Under no circumstance, however, should any employee attempt to handle an emergency situation alone.

7. Following an emergency, facility operation in affected area(s) of the facility will not resume without approval of the emergency coordinator.

The Emergency Coordinator will take appropriate steps to determine and identify the character, exact source, amount, and extent of any released materials. The Emergency Coordinator is also responsible for assessing any possible hazards to human health or the environment which may result from the incident. If outside firefighting assistance is needed, the Emergency Coordinator shall immediately notify the

Chicago Fire Department. If outside compressed gas release assistance is required, the Emergency Coordinator shall immediately notify ETSC.

A list of emergency and safety equipment maintained at the facility, as well as a site map showing the locations of each piece of emergency equipment is presented in CHCI Drawing No. 4221, included in Appendix G-5 of the facility Contingency Plan. The capabilities of the emergency equipment available on-site are summarized in Table G-2 of the facility Contingency Plan. The revised Contingency Plan is included as attachment 4.

The facility also has the following equipment available for handling waste compressed gases:

Cylinder storage racks
Cylinder holders
Cylinder carts
Fork lifts
Cylinder boxes
Containers (5, 16, 30, 55-gallon)

CLEAN HARBORS ENVIRONMENTAL SERVICES, INC.
COMPRESSED GAS CYLINDER PROGRAM AND GUIDELINES

August, 1995

CONTENTS

Appendices

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1.0 INTRODUCTION

There are a variety of reasons why cylinder disposal services are needed. Some non-reusable (non-refillable) cylinders are considered unserviceable after one use. In other cases, some cylinders are found to have been out of service for a long time, inadequately marked or the customer cannot send the compressed gas cylinder(s) back to the supplier. In all cases, these guidelines must be followed to properly and safely provide disposal, return or reclamation services for compressed gas cylinders.

Compressed gas cylinders can be very dangerous if handled by untrained or unqualified individuals. Not only do they contain hazardous gases including flammables, pyrophorics, asphyxiants, oxidizers, corrosives, toxics and poisons, they are also under pressure, can be awkward to move and potentially explosive if subjected to abnormal storage conditions, contaminated or mishandled. These guidelines have been developed to outline the proper steps a trained Clean Harbors employee must follow in evaluating, handling, transporting and storing compressed gas cylinders for disposal or reclamation.

These guidelines only apply to Clean Harbors employees who have been certified through the Corporate Lab Pack Compressed Gas Cylinder training program. Questions on any phase of the cylinder program should be directed to the Cylinder Program Manager at (800) 842-1005 or (508) 655-8863.

2.0 PURPOSE

The intent of the Clean Harbors Lab Pack Product Line Compressed Gas Cylinder Program is to provide our customers with a disposal, recycling or return option for their out-dated, out-of-service or waste cylinders. Our strategy begins with a field inspection of the physical and chemical characteristics of the cylinder contents. From this evaluation an environmentally sound disposal or recycling option can be determined.

Clean Harbors' utilizes off site disposal facilities that specialize in recycling, treatment via hydrolysis and incineration.

With the emphasis on recycling in the 1990's and because of its cost effectiveness, Clean Harbors first choice in cylinder management is the recovery of cylinder contents. We also work with companies which specialize in propane and freon recovery. If the gas supplier is known, return to them is first attempted.

Compressed gas cylinders designated for recycling are classified as commercial chemical products as defined in 40 CFR, Part 261.

Clean Harbors intent is to provide customers with a full service, turn-key operation that includes inspection, packaging and transportation of compressed gas cylinders for final disposition.

3.0 SCOPE

The compressed gas cylinder program includes all of the gas and liquid cylinders our disposal and recycling facilities accept. Those materials we do not store due to health and safety concerns are directly shipped from the customer's site to the ultimate disposal/recycling facility. For those materials we do not transport due to health and safety issues, we subcontract a transporter to direct ship to the ultimate disposal/recycling facility. In some instances, materials we do not accept into our facilities or do not transport are evaluated, packaged and transported by a subcontractor to their final disposal outlet. Some materials are so exotic that there is no disposal facility that will accept them packaged in cylinders. In this case, we may opt to subcontract a company to treat the material on site or repack into containers acceptable to the final disposal facility. In all of these scenarios, Clean Harbors' employees trained in compressed gas cylinder evaluation and handling will perform visual evaluations before it is decided how the material should be handled, transported and by whom.

Refer to the list of cylinders not acceptable at Clean Harbors facilities and those that are acceptable at Clean Harbors facilities (Appendix A and B, respectively). The decision to handle and package the cylinders in Appendix A will be determined by the visual evaluation (integrity, DOT transportability) and where the material can be sent. In all appendix A cases a subcontractor will be utilized to either package, repackage, treat and/or transport the cylinder to its final destination. Appendix B outlines all cylinders acceptable for packaging and transportation by Clean Harbors and storage at Clean Harbors. It also outlines which materials can be placed in the cylinder overpack and which cannot.

Clean Harbors' approved disposal facilities base their acceptance criteria on permits, chemical stability, operational capacity and health and safety. The overriding factor in acceptability is whether or not they are permitted to handle the material. Next they consider the chemical stability of the material, which is directly related to health and safety. Materials that are unstable or have explosive characteristics as is, or during the disposal process, are not acceptable.

Facility acceptance is also based on whether or not the disposal or reclamation facility can handle the material operationally. They must have the proper hardware and equipment available to treat or incinerate the material.

Once it is determined that the material is acceptable, the cylinder is evaluated. The cylinder must be in shippable condition, it must appear to have a working valve (although some facilities will accept plugged cylinders), and in some cases it cannot exceed certain dimensions. Dimension criteria is a result of permits as well as operational limitations. If a cylinder needs to be handled in a glove box or gas cabinet it must be small enough to fit into these devices.

For those materials that Clean Harbors does not have an approved off site disposal option, we consider the options of direct shipment to an unapproved facility or on site treatment by a high hazard remediation company. Likewise, for a cylinder with unknown contents, we can subcontract a high hazard remediation company to sample and analyze the contents.

4.0 RESPONSIBILITIES

Director
-Oversees all Lab Pack Product Line business aspects, field operations including cylinder handling, evaluation, storage and transportation.

Facility Lab Pack Manager
-Oversees cylinder acceptance into Clean Harbors Lab Pack facilities. Oversees proper storage and transportation to final disposal facilities. Involved in cylinder training program and emergency response contingency planning.

Program Manager
-Responsible for all approvals by reviewing cylinder evaluation forms and photos. Involved in determining disposal/recycling outlets before cylinders are accepted. Works on developing business and market strategies. Acts as technical advisor for field chemists, sales and customers.

Lab Pack Specialist
-Responsible for driving all lab pack sales, including cylinders. Trained specialists will occasionally perform cylinder scopes and evaluations.

Compliance Manager
-Responsible for making sure cylinders are shipped and stored in compliance with all DOT, state and federal regulations.

Health & Safety Manager
-Provides knowledge and assistance in health and safety with respect to the evaluation, handling, transportation and storage of compressed gas cylinders.

Field Chemist
-Follows the guidelines set forth when evaluating, handling and transporting compressed gas cylinders.

Plant Lab Pack Chemist
-Follows guidelines set forth when evaluating, handling, transporting and storing compressed gas cylinders. Responsible for preparing cylinders for shipment to disposal facilities. Involved in Cylinder Training Program and emergency response contingency planning.

5.0 DEFINITIONS

Bulging: A physical deformity increasing the diameter of a cylinder that is caused by overpressure resulting from fire or overheating, or possibly due to an internal chemical reaction. Please refer to Appendix C. Cylinder Illustrations.

Compressed Gas Association (CGA): An organization founded in 1913 to develop and promote safe practices in the industrial gas industry. Membership consists of more than 200 member companies representing manufacturers, distributors, suppliers, and transporters of gases and related products.

Compressed Gas: Any gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psia at 70°F.

Cylinder: a vessel designed for pressures higher than 40 pounds per square inch absolute (p.s.i.a.) and having a circular cross section. The materials of construction are either carbon steel, aluminum, various metal alloys or stainless steel depending on the pressure rating required and the corrosivity of the gas.

Dent: any indentation in a cylinder wall or body that does not normally appear during production of the cylinder. Dents can occur from dropping and hitting other objects or other objects hitting the cylinder. A dent that is deeper than 1/10 the greatest dimension of that dent may be considered non-DOT transportable.

Gas Cabinet: An enclosed cabinet designed to dispense gases or chemicals in a controlled manner to a given process and to protect the worker from exposure to dangerous chemicals and gases. The cabinet comes equipped with valve assemblies and purge lines to facilitate the removal of the cylinder contents on a remote basis.

Glove Box: A vapor tight vessel that can be filled with an inert atmosphere for working with pyrophoric liquids. The glove attachments allow the worker to handle containers within the box without exposure to the outside atmosphere.

High Pressure Gas: A gas in a container that has a pressure of 500 psig or higher at 70°F.

Hydrolysis: A chemical reaction in which water reacts with another substance to form two or more substances.

Liquified Compressed Gas: A gas which under the charged pressure is partially liquid at a temperature of 70°F.

Non-liquified Compressed Gas: A gas other than a gas in solution, which under charging pressure is entirely gaseous at 70°F.

Reclamation: The recovery of scrap or unused products (gases) through a mechanical and chemical process in order to reuse or recycle the material.

SNOOP© : A surfactant and water solution used in the industry to test for gas leaks. This solution is non-flammable, non-reactive and non-toxic. It can be used on all types of gases, except for oxidizers and very water soluble gases (i.e. ammonia, chlorine). Common oxidizers encountered in cylinders are chlorine and oxygen. If a leak is present, the surfactant in the SNOOP© will bubble.

6.0 DISCUSSION OF HAZARDS

The hazards presented by compressed gas cylinders range from chemical to physical. The most essential element of hazard control is identification of the hazard and the understanding that every cylinder has multiple hazards. The potential hazards associated with cylinders are:

pressure
flammable
pyrophoric
asphyxiant
oxidizer
corrosive
toxic or poisonous
extremely cold (cryogenic)
material handling

A. General and Physical

Pressure - Typical gas cylinders have pressure ratings ranging from 40 pounds per square inch absolute (psia) to 3000 psia. Exposure to extremely high temperatures or overfilling can result in excessive cylinder pressures and cause bulging or bursting of the vessel. Dropping can cause shearing of the valve which may result in a projectile due to the immediate pressure release.

Weight, Shape, Size - Cylinders come in a wide range of shapes, sizes and materials of construction. Due to the inherent weight of many cylinders, caution must be used when handling containers to guard against dropping or permitting containers to strike against each other, other surfaces or individuals. The noise generated from cylinders striking each other can reach up to 135 decibels.

B. Chemical

Flammable: A solid, liquid or gaseous material which ignites easily and burns in air. The flame and heat propagation rate of a gas is so great as to resemble an explosion, especially if the gas is confined.

ex. acetylene, ethane, hydrogen, hydrogen sulfide, methane, propane, methyl chloride

Pyrophoric: Any liquid, solid or gas that will ignite spontaneously in air at 130°F or lower. These materials present a dangerous fire and explosion risk near combustible materials.

ex. butylethylmagnesium, diisobutylaluminum chloride, diborane, diethylzinc, phosphine, triethylaluminum, silane

Oxidizer: The main hazard associated with oxidizers is fire. "Oxidizers alone are non-flammable, however in the presence of an ignition source and a fuel, can vigorously accelerate combustion" (CGA, P-1, 13). For this reason it is important that any organic materials which can act as a fuel source be kept away. Oil, grease, tar or other combustible substances should never be allowed to come in contact with cylinder valves, regulators or fittings for which an oxidizer is contained (CGA, P-1, 13). It is safe practice not to let any of the above mentioned materials come in contact with cylinder valves, regulators or fittings of any cylinder hazard class.

ex. oxygen, fluorine, chlorine, nitric oxide, chlorine trifluoride

Asphyxiant (inert gases): The hazard associated with all inert gases except oxygen and air is asphyxiation in confined spaces. These gases can displace the oxygen in air which can lead to suffocation. Since most of these gases are odorless and colorless, displacement can occur without warning (CGA, Handbook, 82). These gases are generally not reactive or particularly "toxic".

ex. argon, carbon dioxide, helium, krypton, neon, nitrogen, xenon, refrigerants

Corrosive gases: Corrosive gases attack human tissue. Many gases are in the anhydrous state and are non corrosive. However, when absorbed by water, they become corrosive. Hydrogen chloride, anhydrous will become hydrated when exposed to the moisture in air, hence becoming a corrosive gas (CGA, Handbook, 85). Basic materials, such as ammonia or amines will destroy tissue upon contact. Hydrogen fluoride will have a long lasting capability to destroy tissue. All exposures to HF should be medically treated.

ex. ammonia, amine compounds, boron trichloride, hydrogen fluoride, sulfur dioxide, hydrogen chloride

Toxic or poisonous gases: Any substance which creates an immediate hazard to health by inhalation, ingestion, or skin absorption, and can be fatal in low concentrations.

ex. arsine, carbon monoxide, nitric oxide, nitrogen dioxide, phosgene

Cryogenic liquids: "Cryogenic liquids are gases which are handled in liquid form at relatively low pressures and extremely low temperatures, usually below -150°F" (CGA, P-1, 14). Upon exposure to human tissue these liquids could cause burns similar to frostbite. In addition, higher pressures can result from rapid vaporization of the refrigerated liquid due to rising temperature from leakage of heat into the container (CGA, Handbook, 75). This will normally result in actuation of container pressure relief devices.

ex. liquid oxygen, liquid hydrogen, liquid helium, liquid neon, liquid natural gas, liquid nitrogen

NOTE: Keep in mind that many gases contain multiple hazards, for example chlorine is not only a strong oxidizer, but it is also a corrosive and toxic gas.

For information on specific gases and their associated hazards, please contact Lab Pack Corporate Technical Services. They have a full list of MSDS's and other chemical references for gases.

7.0 GROUPS OF GASES

Section 6.0 outlined the general, physical and chemical hazards associated with all gases. As part of the training for CHES personnel working with and evaluating compressed gas cylinders, the world of gases has been separated into groups of chemically related gases which have common physical properties. Please note that toxological properties can vary from gas to gas. The groups of gases have been separated into the following families:

Inert or Asphyxiant gases

Flammable Gases
- hydrides
- petroleum gases
- organometallics

Acid gases

Caustic Gases

Oxidizers

I. INERT AND ASPHYXIANT GASES

This group includes but is not limited to the following common materials: helium, argon, krypton, xenon, nitrogen, chlorofluorocarbons, sulfur hexafluoride, nitrous oxide.

Some of these compounds are heavier than air and can easily displace oxygen to the extent where the atmosphere cannot support life.

This family also includes some of the cryogenic liquids which will cause frost bite injuries to flesh exposed to the liquid.

Nitrous oxide is also a mild oxidizer.

II. FLAMMABLE GASES

This group is separated into 3 families: hydrides, petroleum gases and organometallics.

Hydrides

The hydride gases as a group contain many of the most flammable, and with the exception of hydrogen, the most toxic of all gases. Examples of hydride gases include: hydrogen, deuterium, hydrogen cyanide, hydrogen sulfide, phosphine, diborane, silane, arsine, germane, stibine, hydrogen selenide.

All hydride gases are flammable and many are pyrophoric when present in concentrations greater than 1%. All, with the exception of hydrogen and deuterium, are severe irritants, and some such as hydrogen sulfide and hydrogen selenide can cause olfactory fatigue which can result in an employee's overexposure if no detection instruments are used.

Petroleum Gases

These gases include all pure, unsubstituted C-H compounds. They also include many petroleum derived high vapor pressure liquids frequently shipped in cylinders. Examples include: methane, ethane, ethylene, propane, butane, cyclopropane, acetylene, allene, butadiene.

All petroleum gases are flammable. Butadiene and ethylene have been designated as suspected human carcinogens. All will act as simple asphyxiants by displacing oxygen.

Organometallics

This group are not generally classified as "gases". They are highly reactive liquids and solids that are packaged and managed in a similar fashion as compressed gases. Examples of organometallics include: trimethyl aluminum, trimethyl gallium, trimethyl stibine, diethyl zinc, dimethyl zinc.

The major hazards aside from flammability are due to extreme reactivity of these compounds. Most are pyrophoric and water reactive.

III. ACID GASES

The acid gases are some of the most toxic gases encountered in the hazardous waste industry. Examples include: hydrogen fluoride, hydrogen chloride, hydrogen bromide, hydrogen iodide, phosgene (carbonyl chloride), phosphorous pentafluoride, sulfur dioxide.

All of these gases are corrosive. Corrosivity toward metals is mainly a function of the amount of water that is present.

As inhalation hazards, the acid gases are acutely toxic. Skin contact can range from severe irritation in low doses to severe burns in high doses. Even in small doses, untreated skin contact to hydrogen fluoride can result in severe burns.

IV. CAUSTIC GASES

As a group, caustic gases are flammable, toxic and have sharp disagreeable odors. Examples include: ammonia, methyl mercaptan, ethylamine, trimethylamine.

Although these gases are corrosive by nature, they are often extremely flammable and have low IDLH values.

Although highly toxic, the caustic gases generally provide adequate warning of their presence.

V. OXIDIZERS

Oxygen is essentially the only gas in this group that is relatively benign. The rest are toxic and many acutely toxic. Examples include: oxygen, chlorine, fluorine, chlorine trifluoride, bromine trifluoride, iodine pentafluoride, nitrogen trifluoride, nitrogen dioxide, nitric oxide.

Flourine and other fluoride compounds are among the most highly reactive oxidizers. ANY trace of organic matter or inorganic oxidizable residue in contact with the gas represents the probability of fire or explosion.

All of the halogens (F, Cl, Br, I) are strong irritants to the lungs and skin and can cause extensive and severe burns. ANY significant exposure requires medical attention.

8.0 PRE-EVALUATION PROCEDURES

8.1 Notification

There are several ways in which Clean Harbors is notified of compressed gas cylinder opportunities. Clean Harbors can be initially notified of cylinders through the generator. This may be in the form of a phone call or an inventory list. In either case, the information is forwarded to the Program Manager, Technical Service Representative and the appropriate Customer Service Account Manager. If the situation is known to be a non emergency (i.e. non-reacting, non-leaking, no suspected problems, etc.) the next operational step is the cylinder evaluation. Disposal pricing can be estimated for the generator and a quote delivered before the evaluation, but acceptance of the cylinder into a Clean Harbors facility is contingent upon evaluation of the cylinder and approval by the Cylinder Program Manager.

Another scenario in notification is through a Clean Harbors employee. Compressed gas cylinders may be discovered by a lab pack chemist during a job, by a Lab Pack Specialist through a scope, or through an Account Manager during a sales call. If the situation is known to be a non emergency (i.e. non-reacting, non-leaking, no suspected problems, etc.) the next operational step is the compressed gas cylinder evaluation.

Lastly, Clean Harbors can be notified by a local fire department, HazMAT squad, State Environmental Agency or EPA. As outlined above an evaluation will be completed if it is a non-emergency.

In the event of an emergency, Clean Harbors will need to send a trained chemist to the site (if the Program Manager is unavailable) to assess the situation and define the nature of the emergency. Based upon the situation it may be dedided by the Program Manager and Health and Safety that Clean Harbors is qualified to handle the cylinder without outside assistance. If it is determined that outside help and/or subcontractors specializing in emergency response and remediation projects are needed, the Program Manager will notify the appropriate subcontractor to help remedy the situation.

8.2 Approaching a cylinder

Essentially, three situations exist when Clean Harbors is first notified of a cylinder disposal request. These situations fall into the following descriptions:

1) **Routine Storage**

The cylinder is still in use in a lab or was recently taken out of the lab and placed aside or in a storage area for disposal.

2) **Controlled Storage**

The cylinder has not been used for a "while" and is in a storage area, but has been recently handled, examined and/or is known to be in good shape.

3) **Uncontrolled Storage**

The cylinder is stored in a deserted or abandoned area or room which has been unoccupied, and there is no relative historical information and/or may be completely unknown.

In situations 1 and 2, the trained cylinder evaluator (field chemist, lab pack specialist, technical service representative, etc.) may approach the compressed gas cylinder in level D protection to perform the initial evaluation unless there is reason to believe there is a problem with the compressed gas cylinder (i.e. the cylinder may be leaking, there is an unknown odor, etc.). **For any cylinder which falls in the range of situation 3, the Program Manager and Health and Safety must be contacted to determine the proper protection and procedures needed to evaluate the compressed gas cylinder.**

9.0 COMPRESSED GAS CYLINDER EVALUATION

Before any individual cylinder can be evaluated, a field chemist must perform a preliminary visual inspection to determine that the material meets minimum qualifications for safe handling and transportation. The criteria to evaluate for the preliminary visual inspection includes denting, corrosion, bulging and leaking conditions associated with the cylinder.

DENTING: The denting of cylinders may cause weakening of the walls sufficient to make the cylinder non-transportable. If the dent in question is deeper than one tenth (1/10) the greatest dimension of that dent, the cylinder may be considered non-transportable. Dents can be measured with accurate measuring tools such as a tape measure or ruler. **SEE APPENDIX C**

When a dent with a weld as part of the dent is present, the cylinder may be considered non-transportable if the greatest depth of the dent is >.25 inches (6.35 mm).

CORROSION: When corrosion of the cylinder body exists there may be an instance when this corrosion has weakened the cylinder enough to render it non-transportable. Deep "pits" in corrosion areas are spots which may weaken the cylinder wall enough to cause an accidental release of gas. There are several ways of quantifying these deep holes or pits. Pits can be measured with accurate measuring tools such as a tape measure or ruler.

A general guideline for field use may be:

A) When general corrosion surrounds an area with a deeper pit(s), the maximum pit depth should not be greater than .042 of an inch.

B) When isolated pits are found not surrounding an area of corrosion, the pit depth should be no greater than .084 of an inch.

BULGING: Bulging in cylinders is a more obvious defect on a cylinder and should be rarely encountered in normal cylinder evaluations. This type of defect can occur by over filling a cylinder, exposure to heat, fire, or material defects inherit in the cylinder itself.

When a bulge in a cylinder is observed and the cause of such defect appears to be caused by heat/fire, the cylinder shall be deemed non-transportable if the paint/coating of the cylinder wall is burnt or cracked off indicating the metal comprising the cylinder has been heated to an extent by the source of heat.

Even if no bulging occurs in this instance, the extent of heat damage should be reported to the Cylinder Program Manager.

In cases where over filling or defect bulges occur the cylinder may be considered non-transportable if the bulge defect is greater than 1% of the normal cylinder measurements. **SEE APPENDIX D**

LEAKING: Proceed with leak testing only if no denting, bulging or corrosion conditions exist. If any of these conditions are present, contact the Cylinder Program Manager before proceeding. When first inspected, if a cylinder is or appears to be leaking, notify the generator immediately and leave the area. Call the Program Manager and/or Health and Safety for information on how to proceed. A leak test must be performed on every cylinder to confirm there are no leaks.

To leak test for minute leaks, use the Snoop© liquid test solution provided and check the areas noted in Appendix E for any leaking that may be occurring. **SEE APPENDIX E. Do not use the snoop for oxidizers and water reactive/soluble material. Use pH paper for water soluble acids or bases and use oxidizer paper for oxidizers.**

Lastly, before any "Cylinder Evaluation Form" is filled out, the cylinder valve outlet MUST be free from all apparatus and plug type devices. This will include plugs, dispersion devices, lab tubing and/or any device attached to the valve outlet of the cylinder. These devices may contain an actual valve leak that could become a problem once the cylinder is at a CHES facility. **To avoid this, the chemist on site should remove the connection only after consultation with the generator, Cylinder Program Manager and Health & Safety.** In some instances the generator may be better equipped and/or prepared to remove these devices. These situations should be handled on a case by case basis and always reported to the Cylinder Program Manager and Health and Safety.

CYLINDER EVALUATION IN THE FIELD

Cylinder evaluation in the field is the first and most important step in removing waste or recyclable cylinders from generator sites. It is important that all steps are followed and the cylinder is examined thoroughly. Following these steps will prevent a number of problems that can occur throughout the cylinder disposal/reclaim process.

The basic document used in the cylinder evaluation, approval and shipping process is the Cylinder Evaluation Form. (C.E.F.) SEE APPENDIX F. By filling this form in correctly and using it **in conjunction with the approval of the Cylinder Program Manager, the chance for a D.O.T. violation or cylinder outlet problem will be greatly minimized if not completely eliminated.**

Plant receiving and shipping systems will follow the information contained on this form to process the cylinder correctly and complete the handling and disposal process.

CYLINDER EVALUATION FORM - (C.E.F.)

1- The results of the leak test, yes (leaking) or no (not leaking) should be circled. As previously stated, **if the cylinder is leaking, the evaluation should be terminated, the generator notified and Corporate Lab Pack Technical Services called for information on how to proceed.** However, after you have left the area, please fill out **as** much on the C.E.F. as you can and make a note from **exactly** where the cylinder was leaking. Also try to note the **size** of the leak by determining how quickly or slowly the leak **is** bubbling (continuously or one bubble every two or three seconds). Note if the leak can be heard.

2- C.E.F. information for generator, chemist information and job specifics will always be filled in. The form should be photocopied before individual cylinder information is documented for jobs with more than one cylinder.

3- Contents of the cylinder should be written in blanks provided. It is of utmost importance that exact chemical constituents be identified and percentages or P.P.M. **written** down. Certain calibration gas mixture's pricing and disposal options will be affected by this. Hazard class and/or P.B.I. (poisonous by inhalation) determination may also be significantly affected. If a label, tag or stencil is not present the cylinder will be considered an unknown. This is standard practice in the compressed gas industry.

Question the generator to see if Binary gas mixtures containing a flammable gas and a nonflammable gas are considered flammable. The labeling on a cylinder will usually be marked flammable if the mixture is considered flammable. Consult **APPENDIX G** for determination of flammability in binary gas mixtures (2 gases) if the concentrations of the gases are known. **For more than binary gas mixtures, consult with the Cylinder Program Manager.**

The poison inhalation hazard zone of some gas mixes can be determined by using the information in APPENDICES H and I.

4- **Dimensions of cylinders should be written on the blanks provided on the C.E.F. As with composition, the size of the cylinder can determine the pricing and disposal outlet of any given cylinder.** Measure the diameter (width) at the widest part of the cylinder. Although the width is normally uniform throughout the length, it often tapers towards the top of the cylinder. In the same location, measure the circumference of the cylinder. Measure the length of the cylinder from the base to the area where the valve screws in. Do not include the valve in the length! Measure to the nearest half inch, rounding up when necessary. If weight is available from the generator or the label, record.

The diameter and length should be measured as accurately as possible using **APPENDIX J** to locate the parameters to be measured.

5- Phase information is pertinent only in those materials that can be liquefied or gaseous under pressure. Material will usually be marked and in some cases smaller cylinders can be tilted to get a "feel" for a liquid cylinder.

6- If you know who the supplier is, colors of cylinders can be important in helping to identify the material contained in them. The compressed gas industry has no standards of color to be used for a given material that is contained in a cylinder. Private gas companies may have proprietary colors unique to their company. When used in conjunction with other information on the cylinder, this information may allow the Program Manager to accept or refuse a piece. **SEE APPENDIX K.**

WARNING: Never attempt to classify a cylinder solely on color markings. The final decision of any cylinder should be given to the Program Manager. This table is only to help you provide the Cylinder Program Manager with more information to aid his/her decision.

7- Markings or symbols may be present on the cylinder body and can provide important manufacturer information. Cylinder symbols and markings should be on the shoulder portion of the cylinder and should not be confused with the valve markings. The cylinder owner's name should be stamped on the "collar" portion of the cylinder. At this time the manufacturer or supplier information should also be added to the C.E.F. **SEE APPENDIX L.**

8- **This section can be used to illustrate any symbols that you** cannot fit into the markings section.

9- **Compressed Gas Association (C.G.A.) outlet information is very important in determining the D.O.T transportability and the facilities to which we may send material. There are a wide variety of standard sizes of valves that may be used for** any one type material. The information for these valve connections may be located on the side of each valve and may or may not be preceded by the letters C.G.A.

The valves of "Lecture" sized cylinders (2" x 12") are usually not marked. When the C.G.A. valve number is identified, cross reference the material in **APPENDIX M** to see if the cylinder valve corresponds with the material it contains.

In the event that there is no number stamped, the C.G.A. outlet may be determined by measuring the major diameter of the outside valve to the thousandth place (example .825), the number of threads per inch, the way the threads go (left or right handed) and if the threads are on the inside or outside of the valve. The Cylinder Program Manager may be able to identify the cylinder valve outlet according to these parameters. Only perform measurements if a dust cap or seal is not in place. Do not remove equipment to take measurements.

10- The pressure relief valve section of the C.E.F. should be checked if the cylinder of concern is equipped with one. These devices are grouped into four major categories.

FUSIBLE PLUG: Pressure relief device activated by temperature in which the plug metal is melted or yields under heat. (non-reclosing)

RUPTURE DISK: Pressure relief device activated by pressure disk, set to rupture at predetermined pressure. (non-reclosing)

FUSIBLE PLUG/RUPTURE DISK COMBINATION: Pressure relief device that combines both types of non-reclosing technologies.

RELIEF VALVE: Pressure relief device which is reclosing and will allow gases to escape then reclose when predetermined pressure level is reached again.

As with the cylinder valves the pressure relief devices should have a burst pressure or "CG" number on them to identify the type. Pressure relief devices are usually located at the bottom of the valve 180 degrees from the valve outlet. Larger cylinders (except poisonous gases) may have more than one pressure relief device, and may have them at either end of the cylinder. Some cylinders are not required or are prohibited from having relief devices. Consult the material in **APPENDIX N.**

11- The comments section should be used to describe the condition of the cylinder and valve, the number of cylinders, any unusual valve connections, etc. Some cylinders will be plugged instead of valved and this should be noted here.

12- Shipping information is one of the most important sections of the C.E.F.. When receiving the disposal facility information from the Cylinder Program Manager, will indicate whether to ship the material as waste or recyclable material.

The material will be transported to the Chicago facility on a manifest. Labeling is either on a hazardous waste label or non-hazardous label depending if the material is state or RCRA regulated.

Forward C.E.F.'s to the Cylinder Program Manager for review and approval. All information on the Cylinder Evaluation Form(s) must be completed and approval given prior to shipping. Incomplete information may hinder the approval, receiving or billing of the cylinder(s).

10.0 CYLINDER APPROVAL

The completed CEF shall be sent to the Cylinder Program Manager for review. A cylinder cannot be taken into a Clean Harbors facility without an approval number, which can only be issued by the Program Manager or his designee. Key considerations for approval or rejection are based upon the same standards that our disposal and reclamation facilities use. Not only will these procedures ensure that a cylinder is safe to handle, but they will also ensure that the cylinder will be accepted by an ultimate disposal or reclamation facility:

a. Contents Labeled - Prior to the disposition of a cylinder, the contents must be clearly marked. The CGA considers product labeling, tagging or stenciling to be an adequate means of identifying the cylinder contents (CGA, P-1, 7). If a cylinder cannot be positively identified through these means, it must be treated as an unknown.

b. Verification of Contents - In addition to stenciling and labeling, there are other factors which can help to confirm the cylinder contents. For example, color schemes, markings, lot numbers, product numbers, valve type, valve outlet design, CGA no., pressure relief device type and pressure rating of the cylinder.

The color scheme of a cylinder is sometimes indicative of the contents if the supplier is known. Only suppliers such as Matheson color code their cyinders. Also, cylinder colors for medical gases are standardized in the industry in the U.S. and Canada.

The CGA outlet can be important in verifying cylinder contents. There are approximately 65 CGA outlets on the market today, each of which is rated for certain classes of gases. Some are rated for only one particular gas, for example, CGA 540 is designed to be used on oxygen cylinders only. If a cylinder is found to contain a non-conforming CGA valve outlet, this is an indication that either the contents are different than what is labeled, the cylinder valve was changed by the owner, or a non-standard valve was used by the supplier. In any case, further investigation will be required before the cylinder is approved.

Similarly, the pressure relief device is indicative of the cylinder contents. While many gases require pressure relief devices by law, there are other gases that are illegal to transport with safety relief devices.

For example, inert gases such as nitrogen, argon, xenon and krypton require pressure relief devices to prevent dangerous pressure buildup within the cylinder in case of overheating or fire. On the other hand, it is illegal to use a pressure relief device on toxic gases such as phosgene, fluorine and nitric oxide. The logic behind the latter situation is that it would be more dangerous to release these gases than to allow pressure to build up within the cylinder.

The pressure rating of a cylinder does not necessarily indicate the contents. However, if we know that the pressure rating is low, then the cylinder should contain a liquid under pressure as opposed to a gas under high pressure. Some examples of frequently encountered liquids under pressure are chlorine, propane, trimethylaluminum, triethylborane, diethylzinc, trichlorosilane, and trifluoroacetyl chloride.

If both the supplier and the serial, product or lot number are known, the supplier can be consulted on the possible contents. Any reputable vendor will always take their own cylinder back if it was not sold outright.

c) Condition of Cylinder - Title 49CFR, para. 173.34 (e)(4) requires that a cylinder be condemned when it leaks, or when corrosion, denting, bulging, or evidence of rough usage exists to the extent that the cylinder is likely to be weakened appreciably. If any of these deformities exist on a cylinder it is not legally transportable and it should not be moved. At this point the evaluation should be terminated.

The supplier of the cylinder or a company specializing in cylinder remediation will be contacted to overpack, transfer, treat on site, or otherwise handle the cylinder.

Most of the physical deformities are easily detectable. However, leaks cannot always be detected through sight and sound. To ensure that a cylinder is not leaking Clean Harbors field chemists perform a leak test using SNOOP© leak detector solution or utilize test papers (pH, oxidizer, sulfide) during every cylinder evaluation.

d) Condition of Valve - A working valve is required by disposal facilities for the emptying of contents. Although a valve should not be opened to check the condition, it should be evaluated for corrosion, leaks, and disfigurement. It should also be checked for oil, grease, or other foreign matter on or near the valve, the presence of which could cause incompatibility with the contents. Lastly, the absence of a valve or the replacement of one with a plug should be noted.

11.0 CYLINDER PACKAGING AND TRANSPORTATION

11.1 Packing and Movement

Lecture bottles, lecture spheres or other cylinders not equipped with a protective cap should be packaged upright in strong wooden boxes. The cylinders should be surrounded by vermiculite to prevent the valve from jarring against the side of the box in transit. Containers should be moved to the transport vehicle by means of a fork lift, drum cart or by carrying.

Small, medium and full sized cylinders need not be overpacked into containers provided a valve cover is in place. **Cylinders not having valve covers or other valve protection sufficient to protect the valve from deformation and breakage resulting from a drop of 7 feet or more onto a concrete floor must not be transported until a valve cover can be obtained and secured to the cylinder.** Even if the cylinder has a valve cap, Clean Harbors recommends the cylinders be placed in appropriate sized containers (16, 30 or 55 gallon drums) surrounded with vermiculite as added protection. Full size cylinders should be moved to the transport vehicle by means of a cylinder cart or a two-wheeled dolly if one is present at the customer's site. A drum cart may be utilized if neither of these options is available. Make sure the cylinder is secured to the cart to prevent its falling.

11.2 Securing in Truck

Lecture bottles or compressed gas cylinders that are overpacked into boxes, kilns or drums should be loaded on the end of the truck closest to the rear door and should be secured with load locks. (Refer to section 11.3 for loading compatibility guidelines).

Full size cylinders should also be loaded as close to the rear door as possible. Cylinders should be secured upright to the side wall of the truck box using two ratchet straps. Hooks for the straps should be affixed to the wall at approximately 18 inches and 48 inches from the floor. In cases where more than 1 full size cylinder will be loaded, cylinders should still be secured upright and against the side wall next to one another. If ratchet straps are not available, the cylinder laid on its side and can be strapped to a pallet. Another option, only to be used as a last resort, is to place the cylinder in a drum and surround with vermiculite. Care must be taken to avoid back strain if handling the cylinder and placing it in a drum.

11.3 Transportation

Properly packaged and secured cylinders should be transported according to the segregation table for hazardous materials found in 49CFR 174.81 (d).

"X" INDICATES THAT MATERIALS CANNOT BE TRANSPORTED TOGETHER.

"O" INDICATES THAT THE MATERIALS CANNOT BE TRANSPORTED TOGETHER UNLESS SEPARATED BY A 4 FOOT BUFFER ZONE IN ALL DIRECTIONS.

A BLANK SPACE IN THE TABLE INDICATES THAT NO RESTRICTIONS APPLY.

12.0 CYLINDER RECEIVING AND WAREHOUSING

12.1 Removal of Cylinders from Trucks

As discussed earlier, all compressed gas cylinders present both chemical and physical hazards. Both hazards must be considered individually when trucks containing cylinders are offloaded. An inspection of the load paperwork by the receiving chemist must be conducted before the truck is entered for offloading. The paperwork will list all contents of the vehicle. This procedure will act as an indicator of any possible hazardous situations to look for upon entering the truck.

Chemical Hazards

All Clean Harbors truck boxes are continuously vented through two port holes located on each side of the truck. These vents will tend to alleviate the possible build up of any chemically hazardous atmospheres resulting from potentially damaged containers through transport. For this reason, all trucks containing pre-evaluated cylinders, cylinders which have passed the acceptance criteria previously designated by this guideline may be entered under level D protection. If there is any indication of a possibly dangerous atmosphere, i.e. fumes, stench, etc., the truck will be immediately evacuated and the contingency plan of Section 13.0 will be activated.

Physical Hazards

After it is confirmed that the contents of the truck do not present chemical hazards, the truck may be physically offloaded. All boxes or 5, 16, 30, and 55 gallon drums containing cylinders may be offloaded utilizing common practice. All cylinders which are not containerized must be unloaded utilizing a cylinder cart. The cylinder must first be unstrapped from the truck and then tilted and placed on the cylinder cart platform. If additional cylinders areon the truck, they must be restrapped until they are unloaded. After it is secured to the cylinder cart utilizing its strapping device, it may be rolled into the warehouse for placement into storage.

12.2 Placement into Storage

After each cylinder has been removed from the truck, it must be re-inspected before it is placed into storage. A plant Lab Pack Chemist will perform a secondary evaluation consisting of the following:

a) Visual inspection confirming the Cylinder Evaluation Form data, previously completed during the initial evaluation of the cylinder.

b) Leak test.

If the initial Cylinder Evalution Form is deemed 100% accurate and if it is again confirmed there are no leaks in the cylinder then it may be placed in storage.

Storage methods must be consistent with RCRA and the **NFPA** Gas Cylinder Segregation Requirement which states that **incompatible gases must be stored 20 feet away from each other, or separated by a five foot high barrier of non combustible materials having a fire resistance rating of at least one half hour. Please refer to the table below:**

Gas Hazard Category	Non-flam	Ox	Flam	Pyro	Toxic
Toxic	C	20ft	20ft	20ft	---
Pyrophoric	C	20ft	20ft	---	20ft
Flammable	C	20ft	---	20ft	20ft
Oxidizing	C	---	20ft	20ft	20ft
Non-flam	---	C	C	C	C

C=compatible

Flammable and non-flammable cylinders can be stored in a 4'x 4'x 6' metal cage. Full sized cylinders are stored upright and chained to the side of the cage. Corrosive, toxic, pyrophoric and oxidizing gases are stored in chemically compatible rows with lab pack materials. Those cylinders that were small enough to overpack are left in their box, pail, kiln pack or drum and palletized. Full sized cylinders are stored at the back of their chemically compatible row, chained to the wall or fixed structured.

13.0 CONTINGENCY PLAN

13.1 General considerations

Contingency planning will encompass the three locations that cylinders will be found; the generator site, in transit and at the Clean Harbors facility. These procedures are to be followed for every leaking, reacting or problem cylinder that is detected.

13.2 Cylinder at generator site

If a leaking cylinder is found at a generator site, immediately evacuate the area. Contact the generator so that he/she may implement their own contingency plan.

Gather as much information as possible on the cylinder, i.e., gas name, MSDS(s), how long has the cylinder been in that location and when was the last time anyone was near it.

Call into the Cylinder Program Manager and Health and Safety with all the information and describe the scenario. Different gases will require a different plan of action, therefore it is pertinent to gather as much information as possible.

The on site chemists will take no further action unless instructed to do so by CHES. The Program Manager will work with Corporate Health and Safety to develop a plan of action and proceed with generator approval.

13.3 Cylinder in transit

If a leaking cylinder is found on any vehicle, evacuate the truck body immediately. Collect the shipping papers and any other paper work pertaining to the cylinder from the truck if it is safe to do so. If it is safe for the driver to do so, the Compressed Gas Association recommends driving the truck to an unpopulated area before evacuating the vehicle.

Call the Program Manager from an upwind location with all the information and describe the scenario. Note what the suspected gas is and how long the driver has been driving. Different gases will require a different plan of action, therefore it is pertinent to gather as much information as possible.

The on site driver will take no further action unless instructed to do so by CHES. The Program Manager and Corporate Health and Safety will develop a plan of action and dispatch an emergency team or subcontract the appropriate cylinder remediation company.

13.4 Cylinder at the Clean Harbors of Chicago, Inc. facility

If a leaking cylinder is found at the facility then the facility's contingency plan will be activated.

13.4.1 Level of PPE

The level of personal protective equipment will be decided by the emergency coordinator once the chemical constituent of the cylinder is known and Corporate Health and Safety has been consulted.

13.4.4 Use of other companies

If at any time CHI feels that it needs additional help there are other companies that may be consulted:

CONSULTANTS

Wayne Sanborn
85 Church Street
West Newbury, MA 01985
Tel/Fax (508) 363-2049

Mel Vasi
4 Hampton Place
Nutley, NJ 07110
Tel. (201) 661-0669

Al Mossman
ALM Safety Associates, Inc.
65 Sarazen Street
Saratoga Springs, NY 12866
Tel. (518) 583-2528
Fax. (518) 583-2539

Neal Langerman
Chemical Safety Associates, Inc.
9163 Chesapeake Drive
San Diego, CA 92123
Tel. (619) 565-0302
Fax. (619) 565-6267

SUBCONTRACTORS

Emergency Technical Services Corp. (ETSC)
711 West Morse Ave.
Schaumburg, IL 60193
Tel. (708) 980-3872
Fax. (708) 980-3057
Contact: Irv Kraut/Tom Rusthoven

Chemcept, Inc.
P.O. Box 97
11 Round Lake Rd.
Round Lake, NY 12151
Tel. (518) 899-9837
Fax. (518) 899-9841
Contact: Dan Ferris or Kevin Ritter

Earth Resources Corporation (ERC)
1227 Marshall Farms Road
Ocoee, FL 34761
Tel. (407) 877-0877
Fax. (407) 877-3622
Contact: Norm Abramson/Bob McBride

REMTC
133 Route 206
Branchville, NJ 07826
Tel. (201) 948-0270
Fax. (201) 948-5972
Contact: Fred Hoverkamp

Integrated Environmental Services, Inc.
1464 Chatthoochee Avenue, NW
Atlanta, GA 30318
Tel. (404) 352-2001
Fax. (404) 352-307
Contact: Keith Jolly

N.E.M.S.
3720 Holland Road
Suite 103
Virg. Beach, VA 23452
Tel. (804) 486-6367
Fax. (804) 463-4876
Contact: Fred Ungaretta

CYLINDER OVERPACK EXPERT

Eugene Ngai
Solkatronic Chemicals Inc.
30 Two Bridges Road
Fairfield, NJ 07004-1530
Tel. (201) 882-7900
Fax. (201) 882-7967

14.0 PROGRAM RE-EVALUATION

Program re-evaluation will be performed on an as needed basis by the Corporate Lab Pack Safety Committee when new information may have an impact on the compressed gas cylinder program.

APPENDIX A

LIST OF CYLINDERS NOT ACCEPTABLE AT CLEAN HARBORS:
TO BE DIRECTLY SHIPPED OR HANDLED BY A SUBCONTRACTOR

CYLINDERS NOT ACCEPTABLE AT CLEAN HARBORS FACILITIES: TO BE DIRECTLY SHIPPED AND/OR HANDLED BY A SUBCONTRACTOR	REASON(S)
ARSINE	2.3, ZONE A
CARBONYL CHLORIDE (PHOSGENE)	2.3, ZONE A
CHLORINE PENTAFLUORIDE	2.3, ZONE A
CYANOGEN	RESTRICTED FROM NATICK
CYANOGEN CHLORIDE	2.3, ZONE A
DIBORANE	2.3, ZONE A
DINITROGEN TETROXIDE (NITROGEN DIOXIDE)	2.3, ZONE A
FLUORINE	2.3, ZONE A
GERMANE	2.3, ZONE A
HYDROGEN CYANIDE	2.3, ZONE A
HYDROGEN FLUORIDE	HEALTH AND SAFETY
HYDROGEN SELENIDE	2.3, ZONE A
~~HYDROGEN SULFIDE~~	~~RESTRICTED FROM NATICK~~
NICKEL CARBONYL	NO OUTLET
NITRIC OXIDE	2.3, ZONE A
NITROGEN TRIOXIDE	2.3, ZONE A
OXYGEN DIFLUORIDE	2.3, ZONE A
PHOSPHINE	2.3, ZONE A
PHOSPHOROUS PENTAFLUORIDE	2.3, ZONE A
SELENIUM HEXAFLUORIDE	2.3, ZONE A
SULFOTEPP	2.3, ZONE A
TELLURIUM HEXAFLUORIDE	2.3, ZONE A

Clean Harbors Services, Inc.
11800 S. Stony Island Ave.
Chicago, IL 60617

EPA ID No. ILD000608471

RCRA Part B License
Request for Permit
April 19, 2003

Volume 6B
Appendices
D-56 through D-62

CleanHarbors
ENVIRONMENTAL SERVICES, INC.

11800 South Stony Island Avenue
Chicago, IL 60617
773.646.6202
Fax 773-646-6381
www.cleanharbors.com

October 25, 2004

Olive-Harvey College
10001 S. Woodlawn Avenue
Chicago, IL 60628

Dear Sir or Madam:

Clean Harbors Services, Inc. (CHSI) is submitting a copy of the Technical Deficiencies to the facility's RCRA Part B permit application submitted May 7, 2003. Please make this available with the RCRA Part B application for public viewing during the renewal period. If a member of the public requests to view the Part B permit renewal, please allow them to view the application. CHSI will have a public meeting on the Part B permit at Olive-Harvey College during the renewal period. If you have any questions concerning the submittal, please contact me at (773) 646-6202, x233.

Sincerely,

James R. Laubsted
Facility Compliance Manager

SERVICES, INC.
11800 SOUTH STONY ISLAND AVENUE • CHICAGO, IL 60617
(773) 646-5111 • FAX (773) 646-0026
Visit our Website at www.cleanharbors.com

November 7, 2001

Mr. Mark A. Schollenberger, P.E.
Illinois Environmental Protection Agency
Bureau of Land - Permit Section
1021 North Grand Avenue East
Springfield, IL 62794-9276

Dear Mr. Schollenberger:

Clean Harbors Services, Inc. (CHSI) submitted a Class 2 permit modification request to the facility's RCRA Part B Permit on October 22, 2001 for authority to wet black powder and six other changes. CHSI is submitting additional information concerning the wetting of black powder.

CHSI intends to use approximately 100 square feet of polyethylene as a cover on the floor of the staging area (Unit R1) in case of spillage of the black powder during the operation. After wetting of the black powder, CHSI will roll-up the polyethylene and dispose of with the black powder or decontaminate by removing any visible contamination through lifting the polyethylene to collect and remove any powder. If necessary to remove contamination, water will be sprayed onto the polyethylene and collected and added to the black powder. If decontaminated, the polyethylene will be sent out with the facility garbage.

If the polyethylene should tear during the operation, the polyethylene will be removed upon completion of the operation. And handled as in the above paragraph. The staging area will be washed with water to collect any powder which may have gone through the tear. This water would be disposed of with the black powder.

If you have any questions or require additional information, please contact me at (773) 646-6202, x233.

Sincerely,

James R. Laubsted
Facility Compliance Manager

DATE: 2/18/2004 J:\73120 - CLEAN HARBOR DESIGN\CALCULATIONS\73120BLD42.SDF
JOB TITLE: CLEAN HARBOR BLD 42 FOAM / WATER

WATER SUPPLY DATA

SOURCE NODE TAG	STATIC PRESS. (PSI)	RESID. PRESS. (PSI)	@	FLOW (GPM)	AVAIL. PRESS. (PSI)	@	TOTAL DEMAND (GPM)	REQ'D PRESS. (PSI)
SOURCE	150.0	81.2		2250.0	138.9		840.7	83.3

AGGREGATE FLOW ANALYSIS:

TOTAL FLOW AT SOURCE	840.7 GPM
TOTAL HOSE STREAM ALLOWANCE AT SOURCE	0.0 GPM
OTHER HOSE STREAM ALLOWANCES	500.0 GPM
TOTAL DISCHARGE FROM ACTIVE SPRINKLERS	340.7 GPM

NODE ANALYSIS DATA

NODE TAG	ELEVATION (FT)	NODE TYPE	PRESSURE (PSI)	DISCHARGE (GPM)	AREA (FT^2)	DENSITY REQ. (GPM/FT^2)	DENSITY ACT. (GPM/FT^2)
SOURCE	102.0	SOURCE	83.3	840.7	- - -	- - -	- - -
FP1	102.0	- - - -	83.1	- - -	- - -	- - -	- - -
FP2	102.0	- - - -	70.1	- - -	- - -	- - -	- - -
FP3	101.0	- - - -	70.1	- - -	- - -	- - -	- - -
UG1	96.0	- - - -	71.9	- - -	- - -	- - -	- - -
UG2	96.0	- - - -	71.4	- - -	- - -	- - -	- - -
UG3	96.0	HOSE STREAM	71.3	500.0	- - -	- - -	- - -
UG4	101.0	- - - -	69.0	- - -	- - -	- - -	- - -
1	102.5	- - - -	68.3	- - -	- - -	- - -	- - -
2	102.5	- - - -	68.2	- - -	- - -	- - -	- - -
3	102.5	- - - -	68.2	- - -	- - -	- - -	- - -
TOR	109.3	- - - -	59.9	- - -	- - -	- - -	- - -
200	111.0	- - - -	28.7	- - -	- - -	- - -	- - -
200A	112.0	K= 5.60	26.2	28.7	83.0	0.300	0.345
200B	112.0	K= 5.60	24.2	27.6	83.0	0.300	0.332
200C	112.0	K= 5.60	22.4	26.5	83.0	0.300	0.319
200D	112.0	K= 5.60	20.4	25.3	83.0	0.300	0.305
201	111.0	- - - -	27.2	- - -	- - -	- - -	- - -
201A	112.0	K= 5.60	24.8	27.9	67.0	0.300	0.417
201B	112.0	K= 5.60	24.1	27.5	67.0	0.300	0.411
201C	112.0	K= 5.60	19.1	24.5	67.0	0.300	0.365
201D	112.0	K= 5.60	17.9	23.7	67.0	0.300	0.353
201E	112.0	K= 5.60	16.6	22.8	67.0	0.300	0.341
202	111.0	- - - -	26.8	- - -	- - -	- - -	- - -
202A	112.0	K= 5.60	25.4	28.2	83.0	0.300	0.340
202B	112.0	K= 5.60	23.5	27.1	83.0	0.300	0.327
202C	112.0	K= 5.60	21.6	26.0	83.0	0.300	0.314
202D	112.0	K= 5.60	19.8	24.9	83.0	0.300	0.300

DATE: 2/18/2004 J:\73120 - CLEAN HARBOR DESIGN\CALCULATIONS\73120BLD42.SDF
JOB TITLE: CLEAN HARBOR BLD 42 FOAM / WATER
PIPE DATA

PIPE TAG END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT		LENGTH (FT)	PRESS. SUM. (PSI)	
Pipe: FP1					840.7	7.981	PL	4.50	PF	0.1
SOURCE	102.0	SRCE	83.3	(N/A)	5.4	120	FTG	L	PE	0.0
FP1	102.0	0.0	83.1	0.0		0.007	TL	17.50	PV	
Pipe: FP2					FIXED PRESSURE LOSS DEVICE					
FP1	102.0	0.0	83.1	0.0	13.0 psi, 840.7 gpm					
FP2	102.0	0.0	70.1	0.0						
Pipe: FP3					840.7	7.981	PL	24.50	PF	0.5
FP2	102.0	0.0	70.1	0.0	5.4	120	FTG	3L2G	PE	0.4
FP3	101.0	0.0	70.1	0.0		0.007	TL	71.50	PV	
Pipe: UG1					840.7	7.981	PL	30.00	PF	0.4
FP3	101.0	0.0	70.1	0.0	5.4	140	FTG	2LG	PE	2.2
UG1	96.0	0.0	71.9	0.0		0.005	TL	69.90	PV	
Pipe: UG2					840.7	10.020	PL	175.00	PF	0.5
UG1	96.0	0.0	71.9	0.0	3.4	140	FTG	2TG	PE	0.0
UG2	96.0	0.0	71.4	0.0		0.002	TL	314.65	PV	
Pipe: UG3					840.7	10.020	PL	30.00	PF	0.0
UG2	96.0	0.0	71.4	0.0	3.4	140	FTG	----	PE	0.0
UG3	96.0	H.S.	71.3	500.0		0.002	TL	30.00	PV	
Pipe: UG4					340.7	7.981	PL	65.00	PF	0.1
UG3	96.0	H.S.	71.3	500.0	2.2	140	FTG	T2L	PE	-2.2
UG4	101.0	0.0	69.0	0.0		0.001	TL	146.13	PV	
Pipe: 1					340.7	6.065	PL	5.50	PF	0.1
UG4	101.0	0.0	69.0	0.0	3.8	120	FTG	2LG	PE	-0.6
1	102.5	0.0	68.3	0.0		0.005	TL	26.50	PV	
Pipe: 2					340.7	6.065	PL	3.00	PF	0.0
1	102.5	0.0	68.3	0.0	3.8	120	FTG	----	PE	0.0
2	102.5	0.0	68.2	0.0		0.005	TL	3.00	PV	
Pipe: 3					340.7	6.065	PL	2.00	PF	0.0
2	102.5	0.0	68.2	0.0	3.8	120	FTG	----	PE	0.0
3	102.5	0.0	68.2	0.0		0.005	TL	2.00	PV	
Pipe: TOR					340.7	3.068	PL	6.83	PF	5.4
3	102.5	0.0	68.2	0.0	14.8	120	FTG	LH	PE	-2.9
TOR	109.3	0.0	59.9	0.0		0.133	TL	40.83	PV	
Pipe: 200					340.7	2.469	PL	44.61	PF	30.4
TOR	109.3	0.0	59.9	0.0	22.8	120	FTG	T4LB	PE	-0.7
200	111.0	0.0	28.7	0.0		0.382	TL	79.61	PV	

DATE: 2/18/2004 J:\73120 - CLEAN HARBOR DESIGN\CALCULATIONS\73120BLD42.SDF

JOB TITLE: CLEAN HARBOR BLD 42 FOAM / WATER

PIPE TAG END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT		LENGTH (FT)		PRESS. SUM. (PSI)
Pipe: 200A					108.0	2.067	PL	4.25	PF	2.1
200	111.0	0.0	28.7	0.0	10.3	120	FTG	EN	PE	-0.4
200A	112.0	5.6	26.2	28.7		0.108	TL	19.25	PV	
Pipe: 200B					79.4	1.610	PL	9.50	PF	2.0
200A	112.0	5.6	26.2	28.7	12.5	120	FTG	----	PE	0.0
200B	112.0	5.6	24.2	27.6		0.207	TL	9.50	PV	
Pipe: 200C					51.8	1.380	PL	9.50	PF	1.9
200B	112.0	5.6	24.2	27.6	11.1	120	FTG	----	PE	0.0
200C	112.0	5.6	22.4	26.5		0.199	TL	9.50	PV	
Pipe: 200D					25.3	1.049	PL	9.50	PF	1.9
200C	112.0	5.6	22.4	26.5	9.4	120	FTG	----	PE	0.0
200D	112.0	5.6	20.4	25.3		0.201	TL	9.50	PV	
Pipe: 201					232.7	2.469	PL	8.25	PF	1.6
200	111.0	0.0	28.7	0.0	15.6	120	FTG	----	PE	0.0
201	111.0	0.0	27.2	0.0		0.189	TL	8.25	PV	
Pipe: 201A					126.4	2.067	PL	3.17	PF	1.9
201	111.0	0.0	27.2	0.0	12.1	120	FTG	N	PE	-0.4
201A	112.0	5.6	24.8	27.9		0.145	TL	13.17	PV	
Pipe: 201B					98.5	2.067	PL	7.66	PF	0.7
201A	112.0	5.6	24.8	27.9	9.4	120	FTG	----	PE	0.0
201B	112.0	5.6	24.1	27.5		0.091	TL	7.66	PV	
Pipe: 201C					71.0	1.610	PL	13.83	PF	5.0
201B	112.0	5.6	24.1	27.5	11.2	120	FTG	4E	PE	0.0
201C	112.0	5.6	19.1	24.5		0.168	TL	29.83	PV	
Pipe: 201D					46.5	1.380	PL	7.66	PF	1.2
201C	112.0	5.6	19.1	24.5	10.0	120	FTG	----	PE	0.0
201D	112.0	5.6	17.9	23.7		0.163	TL	7.66	PV	
Pipe: 201E					22.8	1.049	PL	7.66	PF	1.3
201D	112.0	5.6	17.9	23.7	8.5	120	FTG	----	PE	0.0
201E	112.0	5.6	16.6	22.8		0.166	TL	7.66	PV	
Pipe: 202					106.3	2.469	PL	9.25	PF	0.4
201	111.0	0.0	27.2	0.0	7.1	120	FTG	----	PE	0.0
202	111.0	0.0	26.8	0.0		0.044	TL	9.25	PV	
Pipe: 202A					106.3	2.067	PL	4.25	PF	1.0
202	111.0	0.0	26.8	0.0	10.2	120	FTG	E	PE	-0.4
202A	112.0	5.6	25.4	28.2		0.105	TL	9.25	PV	

DATE: 2/18/2004 J:\73120 - CLEAN HARBOR DESIGN\CALCULATIONS\73120BLD42.SDF
JOB TITLE: CLEAN HARBOR BLD 42 FOAM / WATER

PIPE TAG END NODES	ELEV. (FT)	NOZ. (K)	PT (PSI)	DISC. (GPM)	Q(GPM) VEL(FPS)	DIA(IN) HW(C) FL/FT		LENGTH (FT)	PRESS. SUM. (PSI)	
Pipe: 202B					78.1	1.610	PL	9.50	PF	1.9
202A	112.0	5.6	25.4	28.2	12.3	120	FTG	----	PE	0.0
202B	112.0	5.6	23.5	27.1		0.201	TL	9.50	PV	
Pipe: 202C					50.9	1.380	PL	9.50	PF	1.8
202B	112.0	5.6	23.5	27.1	10.9	120	FTG	----	PE	0.0
202C	112.0	5.6	21.6	26.0		0.193	TL	9.50	PV	
Pipe: 202D					24.9	1.049	PL	9.50	PF	1.9
202C	112.0	5.6	21.6	26.0	9.2	120	FTG	----	PE	0.0
202D	112.0	5.6	19.8	24.9		0.195	TL	9.50	PV	

NOTES:

(1) Calculations were performed by the HASS 7.5 computer program under license no. 2705002620 granted by
HRS Systems, Inc.
4792 LaVista Road
Tucker, GA 30084

(2) The system has been calculated to provide an average imbalance at each node of 0.003 gpm and a maximum imbalance at any node of 0.076 gpm.

(3) Total pressure at each node is used in balancing the system. Maximum water velocity is 22.8 ft/sec at pipe 200.

(4) PIPE FITTINGS TABLE

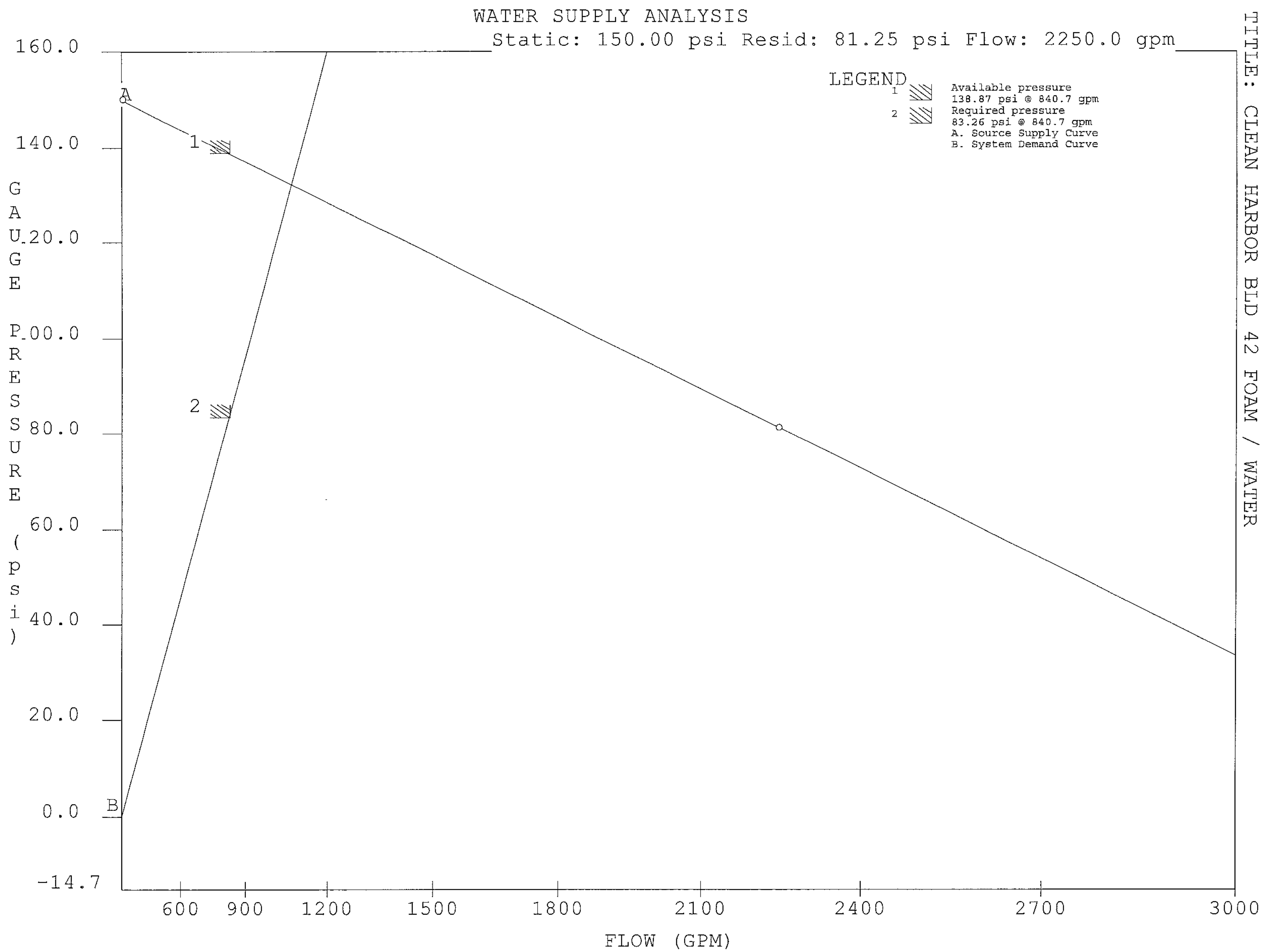
Pipe Table Name: SPHZ.PIP

PAGE: A MATERIAL: S40 HWC: 120

Equivalent Fitting Lengths in Feet

Diameter (in)	E Ell / F 45Ell	T Tee / H VDLVlv	L LngEll / I VDPVlv	C ChkVlv / J VACVlv	B BfyVlv / K RDLVlv	G GatVlv	A RACVlv	D RDPVlv	N NPTee
1.049	2.00	5.00	2.00	5.00	6.00	1.00	9998.00	9998.00	5.00
	1.00	10.00	1.60	10.00	17.10				
1.380	3.00	6.00	2.00	7.00	6.00	1.00	9999.00	9999.00	6.00
	1.00	10.00	1.60	10.00	17.10				
1.610	4.00	8.00	2.00	9.00	6.00	1.00	9999.00	9999.00	8.00
	2.00	10.00	1.60	10.00	17.10				
2.067	5.00	10.00	3.00	11.00	6.00	1.00	9999.00	9999.00	10.00
	2.00	18.00	1.60	10.00	17.10				
2.469	6.00	12.00	4.00	14.00	7.00	1.00	7.70	9.50	12.00
	3.00	9999.00	1.60	10.00	17.10				

3.068	7.00	15.00	5.00	16.00	10.00	1.00	21.509999.00		15.00
	3.00	29.00	1.60	10.00	15.00				
6.065	14.00	30.00	9.00	32.00	10.00	3.00	27.00	47.00	30.00
	7.00	33.00	48.00	20.00	19.00				
7.981	18.00	35.00	13.00	45.00	12.00	4.00	29.009999.00		35.00
	9.00	33.00	48.00	23.00	19.00				
10.020	22.00	50.00	16.00	55.00	19.00	5.009999.009999.00			50.00
	11.00	33.00	48.00	23.00	19.00				


WATER SUPPLY ANALYSIS
Static: 150.00 psi Resid: 81.25 psi Flow: 2250.0 gpm
LEGEND
1 Available pressure
138.87 psi @ 840.7 gpm
2 Required pressure
83.26 psi @ 840.7 gpm
A. Source Supply Curve
B. System Demand Curve
GAUGE PRESSURE (psi)
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-14.7
A
B
1
2
600
900
1200
1500
1800
2100
2400
2700
3000
FLOW (GPM)

DISPERSION TANK
THICKNESS DATA SUMMARY AND ESTIMATES FOR LIFE EXPECTANCY

Design Data

Nominal Capacity	1,493	Gals.
Operating Capacity	1,225	Gals.
Tank Diameter x shell height	6 x 5	Feet
Material of Construction	Carbon Steel	
Year Built	1995	
Allowable Maximum Working Pressure	15	psig.
Actual working Pressure	Atmospheric	
Specific Gravity of Content	1.8	

Some of the Tank Data and thickness data is per Construction Certification Report for Unit 43, submitted 9/15/95.

Material Thicknesses (inches)	**Top**	**Shell**	**Cone Bottom**
Per ASME Code, Section VIII	0.375	0.1875	0.1875
As Built per Shar = T	0.75	0.375	0.375
Tank Bottom Modified in Year 2000 = T			0.5
Established Retirement Thickness			
Without Corrosion allowance = A	0.1875	0.1875	0.1875

UT Test Data	Top Average	Top Minimum	Shell Average	Shell Minimum	Cone Bottom Average	Cone Bottom Minimum	
Year 1997	0.755	0.752	0.35	0.328	0.308	0.297	
Year 1998	0.326	**0.306**	0.33	0.298	0.341	0.332	See Note 3
Year 1999	0.752	0.724	0.347	0.32	0.245	0.208	
Year 2000	0.324	0.32	**0.283**	0.318	0.498	0.496	See notes 3 & 4
Year 2001	0.75	0.75	0.292	**0.274**	**0.423**	**0.414**	See Note 4
Year 2002	0.318	0.318	0.321	0.321	0.491	0.491	See Notes 3 & 4
Year 2003	**0.316**	0.316	0.32	0.32	0.487	0.487	See Notes 3 & 4

Lowest Readings	Top		Shell		Cone Bottom	
Average thickness = C	0.316		0.283		0.423	
Test reading = D		0.306		0.274		0.414

Maximum Thickness loss when compared to estimated as-built thickness							
based on **lowest** average reading = E = (T - C)	0.434		0.092		0.077		
based on **lowest** test reading = F = (T - D)		0.444		0.101		0.086	
Corrosion Rate (2003-1995) over 8 yrs. For Top and Shell and 3 yrs for bottom							
In in/yr = G = E/8	0.05425		0.0115		0.025667		See Note 3 & 4
In in/yr =H = F/8		0.0555		0.012625		0.028667	See Note 3 & 4
In Mills/yr.	54.3	55.5	11.5	12.6	25.7	28.7	
Life Expectancy							
Based on lowest average reading = (C-A)/G	2		8		9		
Based on lowest test reading = (D-A)/H		2		7		8	
Projected year of retirement		**2006**					See Note 5

Notes:

1 Tank is Designed per ASME section VIII, division I, 1992 Edition, 1993 addendum. Design pressure is 15 psig at 150 deg. F.

2 Tank has a dish bottom and dish top.

3 Thickness dat for the Top of the tank seems erronious. This has occurred in four of the seven years. However, the data has been used "as-is" in the analysis. Recommend Thickness be verified before putting the tank in service.

4 Tank bottom was replaced in year 2000, due to errosion damaged caused by a piece of metal cought in between the rake and the tank bottom. Corrosion rate is determined based on the new tank bottom and the years of service since 2000.
At the upper level of the shell, a 0.375 inch thick and 12 inches wide band was installed. Therefore, the thickness data from the area shows up much higher than the rest of the shell. To avoid skewing of the data, the thickness data from this area has not been used in calculating the average thickness of the shell.

5 As indicated in Note 3, above, tank top thickness data seems to be wrong. Howver, the life expectancy is determined based on the data available. Tank has been out of service from 05/2003.
Data for 2002 and 2003 is available as "average values" only. Hence the average and minimum values are identical.
Recommend verifying the thicknesses prior to putting the tank back into service.

6 Minimum and average thickness are obtained from UT test reports for respective years.
7 Due to the variation in the thickness data, for a conservative approach, a lowest thickness reading per category has been selected to develop a maximum corrosion rate.
8 For uniformity, regardless of year of the lowest reading, the reduction in thickness based on the lowest reading has been assumed to have occurred over the life of the tank.
9 Projected year of retirement has been determined by assuming that the corrosion rate to remain constant as calculated by thickness loss.
Corrosion rate and therefore life expectancy have been calculated two ways, one based on lowest average thickness and secondly based on lowest individual reading.
After calculating all six possible life expectancies, the retirement year has been established based on the lowest life expectancy of the six.

OVERFLOW TANK
THICKNESS DATA SUMMARY AND ESTIMATES FOR LIFE EXPECTANCY

Design Data

Nominal Capacity	311	Gals.
Operating Capacity	275	Gals.
Tank Diameter x shell height	2.5 x 7.5	Feet
Material of Construction	Carbon Steel	
Year Built	1995	
Allowable Maximum Working Pressure	15	psig.
Actual working Pressure	Atmospheric	
Specific Gravity of Content	1.8	

Some of the Tank Data and the initial thickness data is per Construction Certification Report for Unit 43

Material Thicknesses (inches)	**Top**	**Shell**	**Cone Bottom**
Per ASME Code, Section VIII	0.1875	0.1875	0.1875
As Built per Shar = T	0.375	0.375	0.375
Established Retirement Thickness			
Without Corrosion allowance = A	0.1875	0.1875	0.1875

UT Test Data	**Average**	**Minimum**	**Average**	**Minimum**	**Average**	**Minimum**
Year 1997	**0.354**	**0.347**	0.382	0.372	0.379	0.368
Year 1998	0.374	0.367	0.373	0.371	0.375	0.369
Year 1999	0.372	0.368	0.371	0.368	0.374	0.374
Year 2000	0.38	0.38	0.377	0.372	0.359	0.356
Year 2001	0.368	0.368	0.372	0.368	**0.355**	**0.352**
Year 2002	0.369	0.369	0.368	0.368	0.371	0.371
Year 2003	0.368	0.368	**0.366**	**0.366**	0.37	0.37

Lowest Readings						
Average thickness = C	0.354		0.366		0.355	
Test reading = D		0.347		0.366		0.352

Maximum Thickness loss when compared to estimated as-built thickness						
based on **lowest** average reading = E = (T - C)	0.021		0.009		0.02	
based on **lowest** test reading = F = (T - D)		0.028		0.009		0.023

Corrosion Rate (2003-1995) over 8 yrs.						
In in/yr = G = E/8	0.002625		0.001125		0.0025	
In in/yr =H = F/8		0.0035		0.001125		0.002875
In Mills/yr.	2.6	3.5	1.1	1.1	2.5	2.9

Life Expectancy						
Based on lowest average reading = (C-A)/G	63		159		67	
Based on lowest test reading = (D-A)/H		46		159		57

Projected year of retirement	**2050**

Notes:

1 Tank is Designed per ASME section VIII, division I, 1992 Edition, 1993 addendum. Design pressure is 15 psig at 150 deg. F.
2 Tank has a cone bottom and dish top.
3 Tank has been out of service from 05/2003.
4 Data for 2002 and 2003 is available as "average values" only. Hence the average and minimum values are identical. Recommend verifying the thicknesses prior to putting the tank back into service.
5 Minimum and average thickness are obtained from UT test reports for respective years.
6 Due to the variation in the thickness data, for a conservative approach, a lowest thickness reading per category has been selected to develop a maximum corrosion rate.
7 For uniformity, regardless of year of the lowest reading, the reduction in thickness based on the lowest reading has been assumed to have occurred over the life of the tank.
8 Projected year of retirement has been determined by assuming that the corrosion rate to remain constant as calculated by thickness loss.
9 Corrosion rate and therefore life expectancy have been calculated two ways, one based on lowest average thickness and secondly based on lowest individual reading.
10 After calculating all six possible life expectancies, the retirement year has been established based on the lowest life expectancy of the six.

Appendix D-56
Structural Calculations for Unit X

Clean Harbors Services, Inc.

Truck Loading/Unloading Pad – Unit X

Loading: Illinois Department of Transportation
Standard Highway Loading of H20-S16-44

A. Data for Trailer
   Axle Load = 42,000# - Dual Wheel Loading
   Wheel Spacing – 18" x 56" x 18"
   No. of Wheels per Axle = 4
   Tire Inflation Pressure = 100 psi
   Tire Contact Area = $\frac{42{,}000\#}{4 \times 100}$ = 105 sq.in.

B. Subgrade and Concrete Data:
   Concrete Flexural Strength MR = 640 psi @ 28 days

Design

1. Safety Factor = 2.0
2. Concrete Working Stress (WS)
   WS = MR/SF = 640/2 = 320 psi
3. Equivalent Single-Wheel from Fig. 4 (See Sheet #2)
   = .775 x 42,000 = 32,550 #
4. Slab Stress per 1000# of Axle Load
   =WS/Axle Load = 320/32.55 = 9.83 psi
5. From Fig. 3 (See Sheet #3)
   Slab Thickness Required = 8.75" < 10" OK
6. Reinforcement
   $A = \frac{2 \times L \times W}{2 \times f} = \frac{2 \times 70 \times 125}{2 \times 24{,}000} = 0.37$ sq.in.

   Use #4 @ 12" c.c Top and Bottom

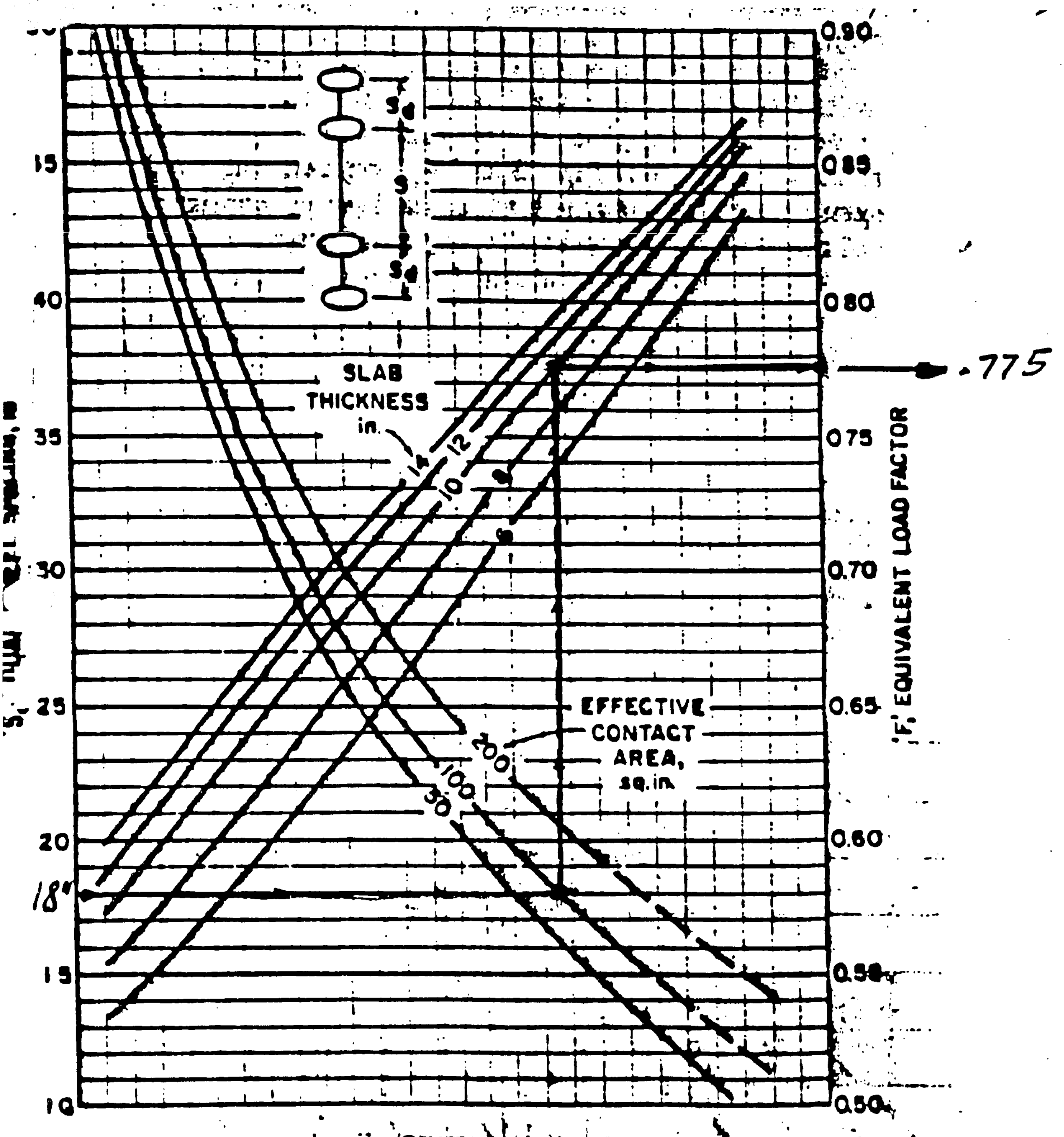


Fig. 4. Design chart for axles with dual wheels

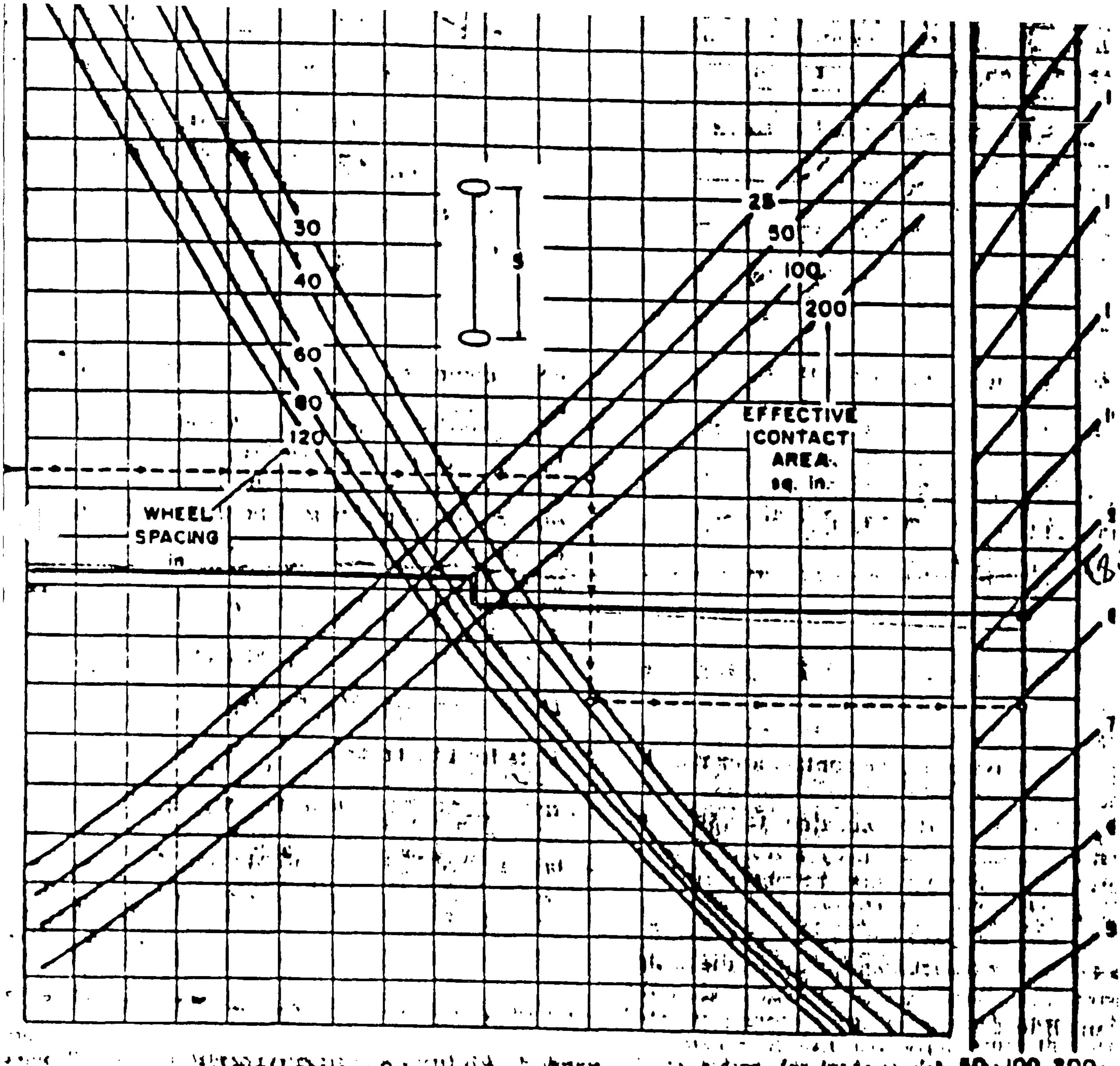


chart for axles with single wheels.

Appendix D-57
Industrial Hygiene Certification

ENVIRONMENTAL SERVICES, INC.
4879 SPRING GROVE AVENUE • CINCINNATI, OH 45232
(513) 681-5738 • FAX (513) 681-7523
Visit our Website at www.cleanharbors.com

October 1, 2004

RE: Lab Pack Pour Off Operation

James Laubsted
Senior Manager, Compliance
Clean Harbors Environmental Services
1180 S. Stony Island Avenue
Chicago, IL 60617

Dear Mr. Laubsted,
I appreciate the opportunity to discuss the ventilation provided for the Lab Pack Pour Off process enclosure. I realize there may be concerns that the capture velocity at the face of the enclosure (an area of approximately 4' x 10') may compromise the adequacy of the ventilation. I have looked at representative face velocity measurement reports for both the Lab Pack Pour Off as well as the Waste Water Treatment enclosures. Both of these process enclosures show face capture velocities predominantly in the low 200 fpm area. While it is true that accepted practice for typical Laboratory hoods recommends capture velocities lower than those of your process enclosures, there are several distinctions between the two that support the higher capture velocities.

Fundamentally, the process enclosures, while they resemble laboratory hood design, differ significantly in their use. Process enclosures are most often intended, as your units are, to be occupied by a worker to perform a unique or time limited task. Laboratory hoods invariably are intended to isolate or significantly limit the worker from direct intrusion into the space defined by the work surface as well as preventing chemical vapors, fumes, etc, from dispersing throughout the laboratory. Typical laboratory hood ventilation does require worker sensitivity to operation of the equipment. Often it is specifically required to maintain a predetermined sash height or opening in order to provide optimal capture velocity and safety to the worker. It is also often a requirement that the workers minimize turbulence in the laboratory hood by minimizing unnecessary hand or arm intrusion into the hood. Process enclosures function more beneficially for the individual working inside of them by providing large volumes of air to be drawn through the space. While there will be potential air turbulence due to the presence of the worker in the space, the larger process enclosure operation (up to six 55 gallon drums may be in the Lab Pack Hood at any time) requires not only higher capture velocity within the work area but reasonably high volumes of air to purge the space while removing contaminants, predominantly VOCs. Based on a 200 fpm average capture velocity, the Lab Pack enclosure is exhausting somewhere around 8000 cubic feet per minute, which provides a very respectable air exchange rate for the enclosure as a whole.

Another item of importance is that it is our practice to require our employees to wear Level C PPE during entry into the enclosures; significantly decreasing the exhaust volume and the capture velocity would invariably require them to work in Level B. It is our standard practice to rely on engineering controls as much as possible in order to minimize the reliance on PPE. It is not only a worker comfort issue but also a safety concern since Level B, as you know, would require air hoses of varying length to be used and impact employee maneuverability.

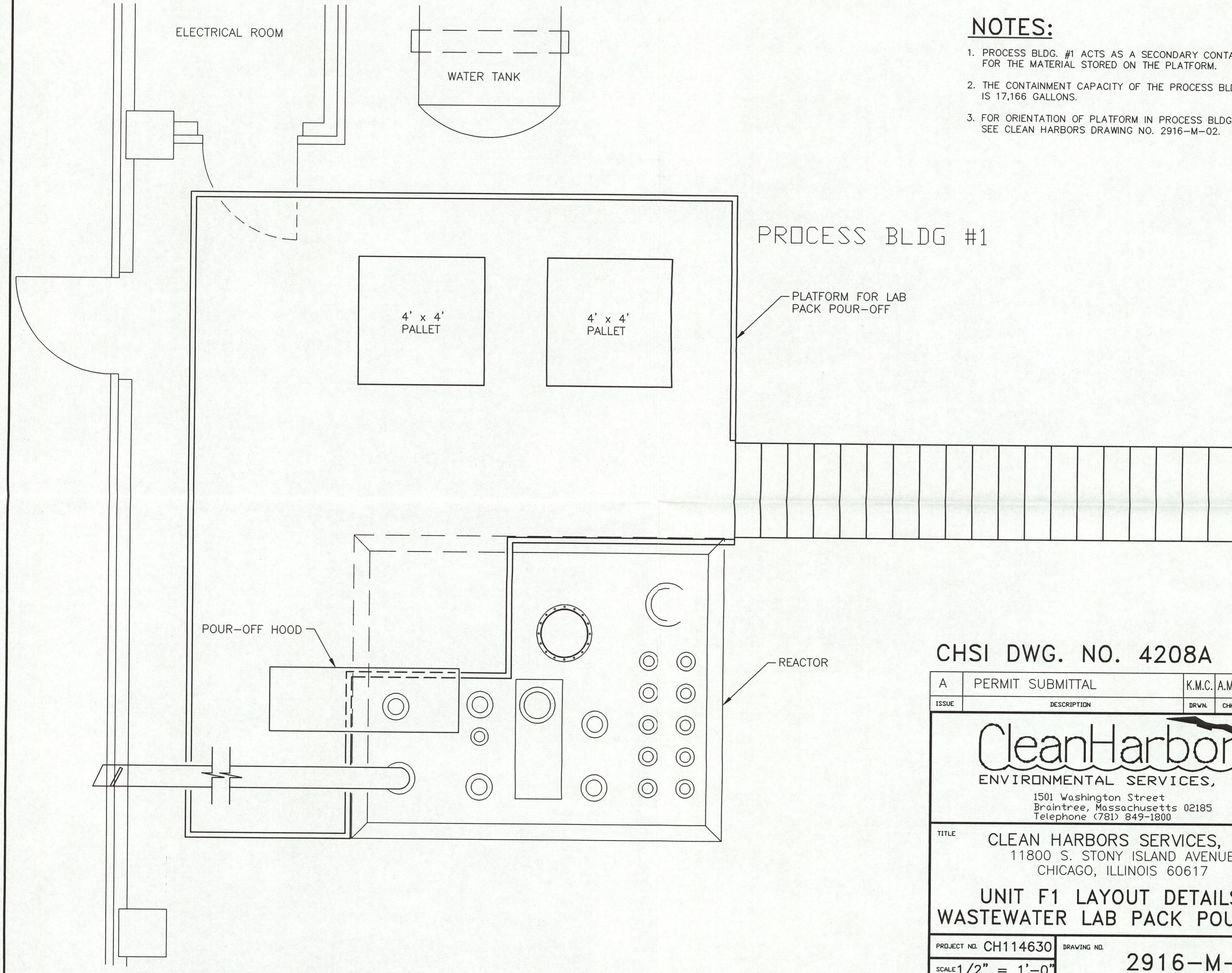
I would not modify the operations you currently have by decreasing the air volume or capture velocity. If, in the future, additional processes or changes to the existing operations occur, I would welcome the opportunity to discuss them as well. Feel free to contact me if I can be of further assistance at our Spring Grove facility in Cincinnati, Ohio.

Thank you,

William J. Hetrick, CIH
Director of Industrial Hygiene
Clean Harbors Environmental Services

THE AMERICAN BOARD OF INDUSTRIAL HYGIENE
INCORPORATED
CERT. NO
1105 C
EXPIRES
6-1-2008
PENNSYLVANIA 1960
WILLIAM J. HETRICK, C.I.H.

Appendix D-58
Unit F-1 Drawing



NOTES:

1. PROCESS BLDG. #1 ACTS AS A SECONDARY CONTAINMENT FOR THE MATERIAL STORED ON THE PLATFORM.
2. THE CONTAINMENT CAPACITY OF THE PROCESS BLDG. #1 IS 17,166 GALLONS.
3. FOR ORIENTATION OF PLATFORM IN PROCESS BLDG. #1 SEE CLEAN HARBORS DRAWING NO. 2916-M-02.

CHSI DWG. NO. 4208A

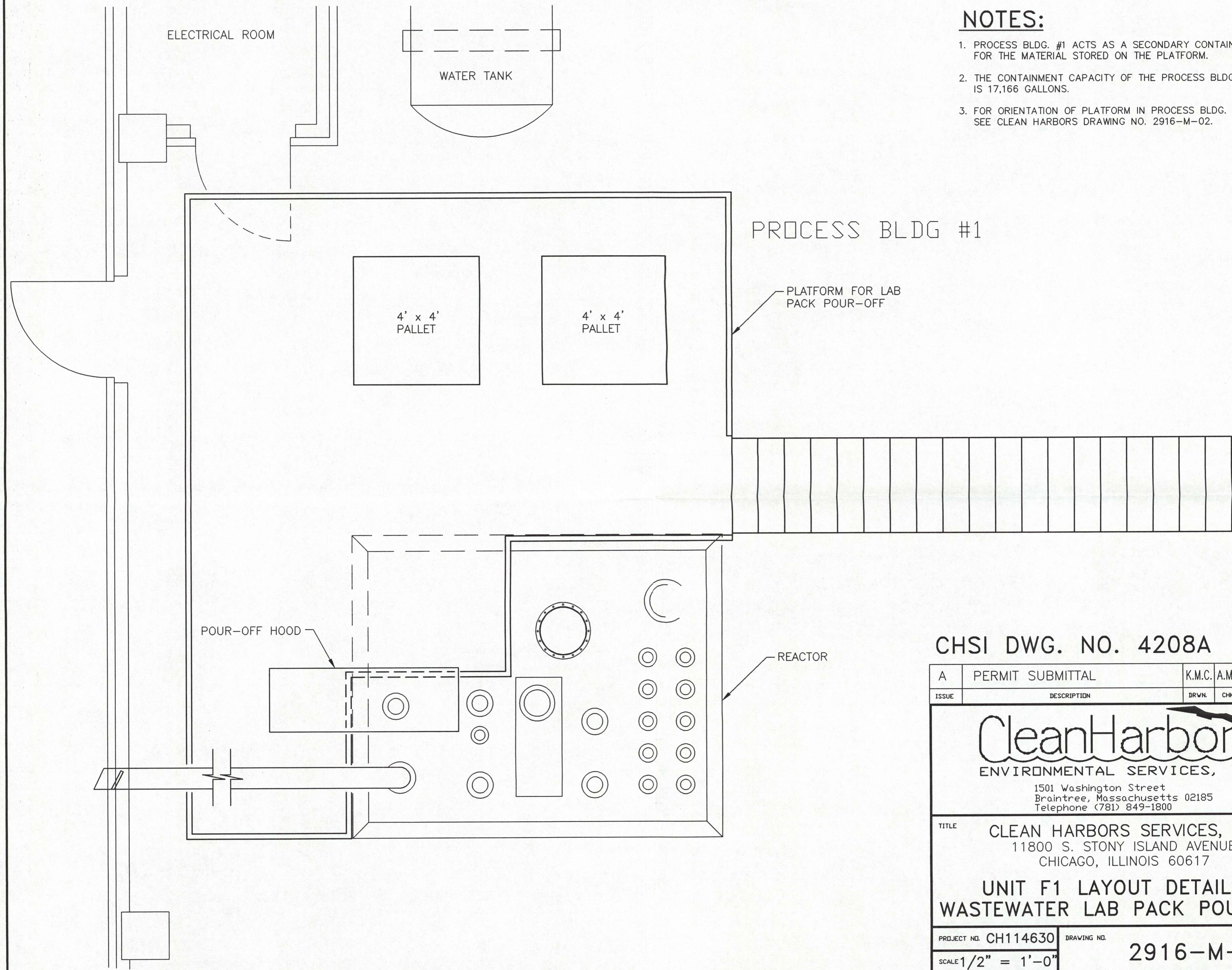
ISSUE	DESCRIPTION	DRWN.	CHKD.	APPR.	DATE
A	PERMIT SUBMITTAL	K.M.C.	A.M.L.	A.M.L.	10/4/04

CleanHarbors
ENVIRONMENTAL SERVICES, INC.
1501 Washington Street
Braintree, Massachusetts 02185
Telephone (781) 849-1800

TITLE
CLEAN HARBORS SERVICES, INC.
11800 S. STONY ISLAND AVENUE
CHICAGO, ILLINOIS 60617

UNIT F1 LAYOUT DETAILS
WASTEWATER LAB PACK POUR-OFF

PROJECT NO. CH114630
SCALE 1/2" = 1'-0"
DRAWING NO. 2916-M-22



NOTES:

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2. THE CONTAINMENT CAPACITY OF THE PROCESS BLDG. #1 IS 17,166 GALLONS.
3. FOR ORIENTATION OF PLATFORM IN PROCESS BLDG. #1 SEE CLEAN HARBORS DRAWING NO. 2916-M-02.

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11800 S. STONY ISLAND AVENUE
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WASTEWATER LAB PACK POUR-OFF

PROJECT NO. CH114630
SCALE 1/2" = 1'-0"
DRAWING NO. 2916-M-22

Appendix D-59
Tank Thickness Testing and Corrosion Rates

TANK RETIREMENT YEAR
SUMMARY
Based on the Analysis of available Actual Thickness Data

Tank No.	Retirement year	Guiding tank section - dictating minimum life	Thickness of the Guiding section - inches	Calculated Corrosion rate of guiding section - mils/yr.
T-101	2022	shell	0.237	4.5
T-102	2015	top	0.192	3.4
T-103	2014	cone bottom	0.316	3.5
T-104	2008	cone bottom	0.298	4.5
T-105	2013	top	0.183	3
T-106	2010	cone bottom	0.302	3.3
T-107	2035	cone bottom	0.36	3.5
[illegible]	[illegible]	cone bottom	[illegible]	[illegible]
T-110	2024	shell	0.23	3.8
T-112	2024	shell	0.247	3

FUELS TANKS - THICKNESS DATA SUMMARY AND ESTIMATES FOR LIFE EXPECTANCY

Tank No. **T-101**

Design Data

Nominal Capacity	12,000	Gals.
Material of Construction	316 Stainless Steel	
Year Built - approximate	1986	
Designed Corrosion allowance	0.0625	in.
Specific Gravity	1.5	

Material Thicknesses (inches)	**Top**	**Shell**	**Cone Bottom**	
Per UL-142 Standard	0.086	0.115	0.158	
As Built per Imperial Fabrication Dwg. 1986	0.25	0.313	0.375	
Estimated actual based on UT test readings = T	0.313	0.313	0.438	
Established Retirement Thickness				
Without Corrosion allowance = A	0.125	0.156	0.25	Per Engineering Report of June
With Corrosion allowance = B	0.156	0.1875	0.281	1995 by Lee Mount

UT Test Data	**Top Average**	**Top Minimum**	**Shell Average**	**Shell Minimum**	**Cone Bottom Average**	**Cone Bottom Minimum**	**Testing Service**
Year 1989	0.32	0.316	0.323	0.31	0.437	0.429	Alpha Consultant
Year 1991	0.316	0.305	0.332	0.32	0.445	0.416	Sirrine Envn. Consultants
Year 1995	0.316	0.303	0.339	0.324	0.439	0.411	MQS
Year 1996	0.318	n/a	0.33	0.302	0.426	**0.4**	MQS
Year 1997	0.305	**0.291**	**0.322**	0.314	**0.426**	0.403	CHES
Year 1998	0.31	0.301	0.325	0.318	0.434	0.401	CHES
Year 1999	**0.294**	0.294	0.345	0.328	0.43	0.368	CHES
Year 2000	0.32	0.32	0.342	0.328	0.443	0.428	CHES
Year 2001	0.312	0.302	0.332	0.326	0.434	0.404	CHES
Year 2002			0.346	0.339	0.431	0.422	Calumet Testing Service
Year 2003			0.337	**0.237**	0.428	0.421	Calumet Testing Service

Lowest Readings	**Top**		**Shell**		**Cone Bottom**	
Average thickness = C	0.294		0.322		0.426	
Test reading = D		0.291		0.237		0.4

Maximum Thickness loss when compared to estimated as-built thickness	**Top**		**Shell**		**Cone Bottom**	
based on **lowest** average reading = E = (T - C)	0.019		-0.009		0.004	
based on **lowest** test reading = F = (T - D)		0.022		0.076		0.038

FUELS TANKS - THICKNESS DATA SUMMARY AND ESTIMATES FOR LIFE EXPECTANCY

Tank No. **T-101**

Corrosion Rate (2003-1986) over 17 yrs.						
In in/yr = G = E/17	0.0011176		0		0.000235	
In in/yr =H = F/17		0.0012941		0.004471		0.002235
In Mills/yr.	1.1	1.3	0	4.5	0.2	2.2
Life Expectancy						
Based on lowest average reading = (C-B)/G	123		Infinite		616	
Based on lowest test reading = (D-A)/H		128		18		67
Projected year of retirement				**2022**		

Notes:

1. Estimated actual thickness and estimated retirement thickness are taken form the engineering report by Lee Mount, dated June 19th 1995.
2. Minimum and average thickness are obtained from UT test reports for respective years.
3. Due to the variation in the thickness data, for a conservative approach, a lowest thickness reading per category has been selected to develop a maximum corrosion rate.
4. For uniformity, regardless of year of the lowest reading, the reduction in thickness based on the lowest reading has been assumed to have occurred over the life of the tank.
5. Projected year of retirement has been determined by assuming that the corrosion rate to remain constant as calculated by thickness loss.
6. Corrosion rate and therefore life expectancy have been calculated two ways, one based on lowest average thickness

FUELS TANKS - THICKNESS DATA SUMMARY AND ESTIMATES FOR LIFE EXPECTANCY

Tank No. T-102

Design Data

Nominal Capacity	12,000	Gals.
Material of Construction	A-285-C	Steel
Year Built - approximate	1986	
Designed Corrosion allowance	0.0625	in.
Specific Gravity	1.5	

Material Thicknesses (inches)	Top	Shell	Cone Bottom	
Per UL-142 Standard	0.123	0.167	0.24	
As Built per Imperial Fabrication Dwg. 1986 = T	0.25	0.313	0.375	
Established Retirement Thickness				
Without Corrosion allowance = A	0.125	0.156	0.25	Per Engineering Report of June
With Corrosion allowance = B	0.156	0.1875	0.281	1995 by Lee Mount

UT Test Data	Top Average	Top Minimum	Shell Average	Shell Minimum	Cone Bottom Average	Cone Bottom Minimum	Testing Service
Year 1989	0.253	0.248	0.317	0.31	0.38	0.371	Alpha Consultant
Year 1991	0.311	0.3	0.307	0.299	0.399	0.389	Sirrine Envn. Consultants
Year 1995							MQS
Year 1996	0.246	0.236	0.312	0.304	0.384	0.382	MQS
Year 1997	0.235	0.226	0.298	0.288	0.365	0.361	CHES
Year 1998	0.236	0.224	0.304	0.286	0.372	0.366	CHES
Year 1999	**0.192**	**0.192**	0.301	0.292	0.371	0.368	CHES
Year 2000	0.226	0.224	**0.286**	**0.264**	0.366	0.364	CHES
Year 2001	0.22	0.218	0.286	0.27	0.362	0.36	CHES
Year 2002			0.325	0.311	0.356	0.354	Calumet Testing Service
Year 2003			0.324	0.31	**0.354**	**0.351**	Calumet Testing Service

	Top		Shell		Cone Bottom	
Lowest Readings						
Average thickness = C	0.192		0.286		0.354	
Test reading = D		0.192		0.264		0.351
Maximum Thickness loss when compared to estimated as-built thickness						
based on lowest average reading = E = (T - C)	0.058		0.027		0.021	
based on lowest test reading = F = (T - D)		0.058		0.049		0.024
Corrosion Rate (2003-1986) over 17 yrs.						
In in/yr = G = E/17	0.0034118		0.001588		0.001235	
In in/yr =H = F/17		0.0034118		0.002882		0.001412

In Mills/yr.	3.4	3.4	1.6	2.9	1.2	1.4

Life Expectancy						
Based on lowest average reading = (C-B)/G	11		62		59	
Based on lowest test reading = (D-A)/H		20		37		72

Projected year of retirement	**2015**

Notes:

1. Estimated actual thickness and estimated retirement thickness are taken form the engineering report by Lee Mount, dated June 19th 1995.
2. Minimum and average thickness are obtained from UT test reports for respective years.
3. Due to the variation in the thickness data, for a conservative approach, a lowest thickness reading per category has been selected to develop a maximum corrosion rate.
4. For uniformity, regardless of year of the lowest reading, the reduction in thickness based on the lowest reading has been assumed to have occurred over the life of the tank.
5. Projected year of retirement has been determined by assuming that the corrosion rate to remain constant as calculated by thickness loss.
6. Corrosion rate and therefore life expectancy have been calculated two ways, one based on lowest average thickness and secondly based on lowest individual reading.
When calculating life expectancy based on lowest average thickness, retirement thickness with corrosion allowance has been used. However, when calculating it based on lowest individual reading, just the minimum retirement thickness has been utilized.
7. After calculating all six possible life expectancies, the retirement year has been established based on the lowest life expectancy of the six.

FUELS TANKS - THICKNESS DATA SUMMARY AND ESTIMATES FOR LIFE EXPECTANCY

Tank No. T-103

Design Data

Nominal Capacity	12,000	Gals.
Material of Construction	A-285-C	Steel
Year Built - approximate	1986	
Designed Corrosion allowance	0.0625	in.
Specific Gravity	1.5	

Material Thicknesses (inches)	Top		Shell		Cone Bottom		
Per UL-142 Standard	0.123		0.167		0.24		
As Built per Imperial Fabrication Dwg. 1986 = T	0.25		0.313		0.375		
Established Retirement Thickness							
Without Corrosion allowance = A	0.125		0.156		0.25		Per Engineering Report of June
With Corrosion allowance = B	0.156		0.1875		0.281		1995 by Lee Mount
UT Test Data	Average	Minimum	Average	Minimum	Average	Minimum	Testing Service
Year 1989	0.255	0.252	0.317	0.31	0.383	0.382	Alpha Consultant
Year 1991	0.254	0.248	0.317	0.299	0.388	0.383	Sirrine Envn. Consultants
Year 1995							MQS
Year 1996	0.236	0.224	0.299	0.282	0.361	0.355	MQS
Year 1997	0.236	0.222	0.294	0.285	0.354	0.347	CHES
Year 1998	0.233	0.222	0.29	0.28	0.352	0.346	CHES
Year 1999	0.234	0.206	0.288	0.28	0.349	0.342	CHES
Year 2000	**0.211**	**0.196**	0.283	0.276	0.345	0.344	CHES
Year 2001	0.215	0.21	0.287	0.272	0.337	0.33	CHES
Year 2002			0.275	0.268	0.317	0.312	Calumet Testing Service
Year 2003			**0.273**	**0.268**	**0.316**	**0.311**	Calumet Testing Service
Lowest Readings							
Average thickness = C	0.211		0.273		0.316		
Test reading = D		0.196		0.268		0.311	
Maximum Thickness loss when compared to estimated as-built thickness							
based on **lowest** average reading = E = (T - C)	0.039		0.04		0.059		
based on **lowest** test reading = F = (T - D)		0.054		0.045		0.064	
Corrosion Rate (2003-1986) over 17 yrs.							
In in/yr = G = E/17	0.0022941		0.002353		0.003471		
In in/yr =H = F/17		0.0031765		0.002647		0.003765	

In Mills/yr.	2.3	3.2	2.4	2.6	3.5	3.8
Life Expectancy						
Based on lowest average reading = (C-B)/G	24		36		10	
Based on lowest test reading = (D-A)/H		22		42		16
Projected year of retirement					**2014**	

Notes:

1. Estimated actual thickness and estimated retirement thickness are taken form the engineering report by Lee Mount, dated June 19th 1995.
2. Minimum and average thickness are obtained from UT test reports for respective years.
3. Due to the variation in the thickness data, for a conservative approach, a lowest thickness reading per category has been selected to develop a maximum corrosion rate.
4. For uniformity, regardless of year of the lowest reading, the reduction in thickness based on the lowest reading has been assumed to have occurred over the life of the tank.
5. Projected year of retirement has been determined by assuming that the corrosion rate to remain constant as calculated by thickness loss.
6. Corrosion rate and therefore life expectancy have been calculated two ways, one based on lowest average thickness and secondly based on lowest individual reading.
When calculating life expectancy based on lowest average thickness, retirement thickness with corrosion allowance has been used. However, when calculating it based on lowest individual reading, just the minimum retirement thickness has been utilized.
7. After calculating all six possible life expectancies, the retirement year has been established based on the lowest life expectancy of the six.

FUELS TANKS - THICKNESS DATA SUMMARY AND ESTIMATES FOR LIFE EXPECTANCY

Tank No. **T-104**

Design Data

Nominal Capacity	12,000	Gals.
Material of Construction	A-285-C	Steel
Year Built - approximate	1986	
Designed Corrosion allowance	0.0625	in.
Specific Gravity	1.5	

Material Thicknesses (inches)	**Top**	**Shell**	**Cone Bottom**	
Per UL-142 Standard	0.123	0.167	0.24	
As Built per Imperial Fabrication Dwg. 1986 = T	0.25	0.313	0.375	
Established Retirement Thickness				
Without Corrosion allowance = A	0.125	0.156	0.25	Per Engineering Report of June
With Corrosion allowance = B	0.156	0.1875	0.281	1995 by Lee Mount

UT Test Data	Top Average	Top Minimum	Shell Average	Shell Minimum	Cone Bottom Average	Cone Bottom Minimum	**Testing Service**
Year 1989	0.247	0.246	0.311	0.306	0.386	0.385	Alpha Consultant
Year 1991	0.241	0.238	0.308	0.298	0.387	0.378	Sirrine Envn. Consultants
Year 1995							MQS
Year 1996	0.222	0.213	0.295	0.275	0.374	0.375	MQS
Year 1997	**0.216**	**0.203**	0.291	0.285	0.36	0.356	CHES
Year 1998	0.31	0.301	0.324	**0.256**	0.434	0.401	CHES
Year 1999	0.219	0.214	0.287	0.282	0.351	0.342	CHES
Year 2000	0.234	0.22	0.323	0.268	0.316	0.308	CHES
Year 2001	0.308	0.212	**0.277**	0.262	0.308	0.302	CHES
Year 2002			0.287	0.272	0.301	0.295	Calumet Testing Service
Year 2003			0.286	0.271	**0.298**	**0.294**	Calumet Testing Service

Lowest Readings	Top		Shell		Cone Bottom	
Average thickness = C	0.216		0.277		0.298	
Test reading = D		0.203		0.256		0.294

Maximum Thickness loss when compared to estimated as-built thickness	Top		Shell		Cone Bottom	
based on **lowest** average reading = E = (T - C)	0.034		0.036		0.077	
based on **lowest** test reading = F = (T - D)		0.047		0.057		0.081

Corrosion Rate (2003-1986) over 17 yrs.	Top		Shell		Cone Bottom	
In in/yr = G = E/17	0.002		0.002118		0.004529	
In in/yr =H = F/17		0.0027647		0.003353		0.004765

In Mills/yr.	2.0	2.8	2.1	3.4	4.5	4.8
Life Expectancy						
Based on lowest average reading = (C-B)/G	30		42		4	
Based on lowest test reading = (D-A)/H		28		30		9
Projected year of retirement					**2008**	

Notes:
1. Estimated actual thickness and estimated retirement thickness are taken form the engineering report by Lee Mount, dated June 19th 1995.
2. Minimum and average thickness are obtained from UT test reports for respective years.
3. Due to the variation in the thickness data, for a conservative approach, a lowest thickness reading per category has been selected to develop a maximum corrosion rate.
4. For uniformity, regardless of year of the lowest reading, the reduction in thickness based on the lowest reading has been assumed to have occurred over the life of the tank.
5. Projected year of retirement has been determined by assuming that the corrosion rate to remain constant as calculated by thickness loss.
6. Corrosion rate and therefore life expectancy have been calculated two ways, one based on lowest average thickness and secondly based on lowest individual reading.
When calculating life expectancy based on lowest average thickness, retirement thickness with corrosion allowance has been used. However, when calculating it based on lowest individual reading, just the minimum retirement thickness has been utilized.
7. After calculating all six possible life expectancies, the retirement year has been established based on the lowest life expectancy of the six.

FUELS TANKS - THICKNESS DATA SUMMARY AND ESTIMATES FOR LIFE EXPECTANCY

Tank No. T-105

Design Data

Nominal Capacity	12,000	Gals.
Material of Construction	Carbon	Steel
Year Built - approximate	1981	
Designed Corrosion allowance	0.0625	in.
Specific Gravity	1.5	

Material Thicknesses (inches)	Top	Shell	Cone Bottom	
Per UL-142 Standard	0.123	0.167	0.24	
As Built per Imperial Fabrication Dwg. 1986 = T	0.25	0.313	0.375	
Established Retirement Thickness				
Without Corrosion allowance = A	0.125	0.156	0.25	Per Engineering Report of June
With Corrosion allowance = B	0.156	0.1875	0.281	1995 by Lee Mount

UT Test Data	Top Average	Top Minimum	Shell Average	Shell Minimum	Cone Bottom Average	Cone Bottom Minimum	Testing Service
Year 1989	0.25	0.238	0.305	0.303	0.38	0.375	Alpha Consultant
Year 1991	0.254	0.25	0.299	0.277	0.398	0.38	Sirrine Envn. Consultants
Year 1995							MQS
Year 1996	0.22	0.197	0.284	0.262	0.377	0.361	MQS
Year 1997	0.205	0.188	0.271	0.24	0.36	0.341	CHES
Year 1998	0.22	0.201	0.256	0.219	0.344	0.33	CHES
Year 1999	0.19	0.176	0.251	0.22	0.339	0.32	CHES
Year 2000	**0.183**	**0.172**	0.252	0.218	0.342	0.338	CHES
Year 2001	0.248	0.192	0.25	**0.214**	0.334	0.316	CHES
Year 2002			0.236	0.224	0.324	0.318	Calumet Testing Service
Year 2003			**0.235**	0.22	**0.322**	**0.316**	Calumet Testing Service

Lowest Readings	Top Average	Top Minimum	Shell Average	Shell Minimum	Cone Bottom Average	Cone Bottom Minimum
Average thickness = C	0.183		0.235		0.322	
Test reading = D		0.172		0.214		0.316

Maximum Thickness loss when compared to estimated as-built thickness	Top Average	Top Minimum	Shell Average	Shell Minimum	Cone Bottom Average	Cone Bottom Minimum
based on **lowest** average reading = E = (T - C)	0.067		0.078		0.053	
based on **lowest** test reading = F = (T - D)		0.078		0.099		0.059

Corrosion Rate (2003-1981) over 22 yrs.	Top Average	Top Minimum	Shell Average	Shell Minimum	Cone Bottom Average	Cone Bottom Minimum
In in/yr = G = E/22	0.0030455		0.003545		0.002409	
In in/yr =H = F/22		0.0035455		0.0045		0.002682

In Mills/yr.	3.0	3.5	3.5	4.5	2.4	2.7

Life Expectancy						
Based on lowest average reading = (C-B)/G	9		13		17	
Based on lowest test reading = (D-A)/H		13		13		25

Projected year of retirement	**2013**

Notes:
1. Estimated actual thickness and estimated retirement thickness are taken form the engineering report by Lee Mount, dated June 19th 1995.
2. Minimum and average thickness are obtained from UT test reports for respective years.
3. Due to the variation in the thickness data, for a conservative approach, a lowest thickness reading per category has been selected to develop a maximum corrosion rate.
4. For uniformity, regardless of year of the lowest reading, the reduction in thickness based on the lowest reading has been assumed to have occurred over the life of the tank.
5. Projected year of retirement has been determined by assuming that the corrosion rate to remain constant as calculated by thickness loss.
6. Corrosion rate and therefore life expectancy have been calculated two ways, one based on lowest average thickness and secondly based on lowest individual reading.
When calculating life expectancy based on lowest average thickness, retirement thickness with corrosion allowance has been used. However, when calculating it based on lowest individual reading, just the minimum retirement thickness has been utilized.
7. After calculating all six possible life expectancies, the retirement year has been established based on the lowest life expectancy of the six.

FUELS TANKS - THICKNESS DATA SUMMARY AND ESTIMATES FOR LIFE EXPECTANCY

Tank No. **T-106**

Design Data

Nominal Capacity	12,000	Gals.
Material of Construction	Carbon	Steel
Year Built - approximate	1981	
Designed Corrosion allowance	0.0625	in.
Specific Gravity	1.5	

Material Thicknesses (inches)	**Top**	**Shell**	**Cone Bottom**	
Per UL-142 Standard	0.123	0.167	0.24	
As Built per Imperial Fabrication Dwg. 1986 = T	0.25	0.313	0.375	
Established Retirement Thickness				
Without Corrosion allowance = A	0.125	0.156	0.25	Per Engineering Report of June
With Corrosion allowance = B	0.156	0.1875	0.281	1995 by Lee Mount

UT Test Data	**Top Average**	**Top Minimum**	**Shell Average**	**Shell Minimum**	**Cone Bottom Average**	**Cone Bottom Minimum**	**Testing Service**
Year 1989	0.25	0.247	0.304	0.301	0.381	0.378	Alpha Consultant
Year 1991	0.252	0.25	0.295	0.278	0.394	0.387	Sirrine Envn. Consultants
Year 1995							MQS
Year 1996	0.236	0.222	0.288	0.264	0.364	0.362	MQS
Year 1997	0.223	0.209	0.272	0.257	0.361	0.355	CHES
Year 1998	0.21	0.194	0.264	0.248	0.353	0.347	CHES
Year 1999	**0.2**	**0.162**	0.263	0.244	0.347	0.344	CHES
Year 2000	0.204	0.196	**0.25**	0.234	0.334	0.332	CHES
Year 2001	0.232	0.206	0.258	**0.231**	0.332	0.326	CHES
Year 2002			0.255	0.234	0.305	0.301	Calumet Testing Service
Year 2003			0.253	0.233	**0.302**	**0.3**	Calumet Testing Service

Lowest Readings	Top		Shell		Cone Bottom	
Average thickness = C	0.2		0.25		0.302	
Test reading = D		0.162		0.231		0.3

Maximum Thickness loss when compared to estimated as-built thickness	Top		Shell		Cone Bottom	
based on **lowest** average reading = E = (T - C)	0.05		0.063		0.073	
based on **lowest** test reading = F = (T - D)		0.088		0.082		0.075

Corrosion Rate (2003-1981) over 22 yrs.	Top		Shell		Cone Bottom	
In in/yr = G = E/22	0.0022727		0.002864		0.003318	
In in/yr =H = F/22		0.004		0.003727		0.003409

In Mills/yr.	2.3	4.0	2.9	3.7	3.3	3.4
Life Expectancy						
Based on lowest average reading = (C-B)/G	19		22		6	
Based on lowest test reading = (D-A)/H		9		20		15
Projected year of retirement					**2010**	

Notes:

1. Estimated actual thickness and estimated retirement thickness are taken form the engineering report by Lee Mount, dated June 19th 1995.
2. Minimum and average thickness are obtained from UT test reports for respective years.
3. Due to the variation in the thickness data, for a conservative approach, a lowest thickness reading per category has been selected to develop a maximum corrosion rate.
4. For uniformity, regardless of year of the lowest reading, the reduction in thickness based on the lowest reading has been assumed to have occurred over the life of the tank.
5. Projected year of retirement has been determined by assuming that the corrosion rate to remain constant as calculated by thickness loss.
6. Corrosion rate and therefore life expectancy have been calculated two ways, one based on lowest average thickness and secondly based on lowest individual reading.
When calculating life expectancy based on lowest average thickness, retirement thickness with corrosion allowance has been used. However, when calculating it based on lowest individual reading, just the minimum retirement thickness has been utilized.
7. After calculating all six possible life expectancies, the retirement year has been established based on the lowest life expectancy of the six.

FUELS TANKS - THICKNESS DATA SUMMARY AND ESTIMATES FOR LIFE EXPECTANCY

Tank No. T-107

Design Data

Nominal Capacity	12,000	Gals.
Material of Construction	316 Stainless	Steel
Year Built - approximate	1981(?)	
Designed Corrosion allowance	0.0625	in.
Specific Gravity	1.5	

Material Thicknesses (inches)	Top	Shell	Cone Bottom	
Per UL-142 Standard	0.086	0.115	0.158	
As Built per Imperial Fabrication Dwg. 1986	0.25	0.313	0.375	
Estimated actual based on UT test readings = T	0.313	0.313	0.438	
Established Retirement Thickness				
Without Corrosion allowance = A	0.125	0.156	0.25	Per Engineering Report of June
With Corrosion allowance = B	0.156	0.1875	0.281	1995 by Lee Mount

UT Test Data	Top Average	Top Minimum	Shell Average	Shell Minimum	Cone Bottom Average	Cone Bottom Minimum	Testing Service
Year 1989	**0.261**	0.252	0.322	0.316	0.386	0.386	Alpha Consultant
Year 1991	0.27	0.265	0.341	0.318	0.402	0.398	Sirrine Envn. Consultants
Year 1995							MQS
Year 1996	0.268	0.265	0.327	0.31	0.392	0.389	MQS
Year 1997	0.265	0.26	0.323	0.306	0.387	0.386	CHES
Year 1998	0.268	0.266	0.33	0.31	0.39	0.386	CHES
Year 1999	0.272	0.268	0.337	0.32	0.403	0.396	CHES
Year 2000	0.323	0.322	0.336	0.318	0.401	0.396	CHES
Year 2001	0.27	**0.264**	0.324	0.318	0.394	0.386	CHES
Year 2002			0.316	0.308	0.382	0.375	Calumet Testing Service
Year 2003			**0.315**	**0.305**	**0.375**	**0.36**	Calumet Testing Service

FUELS TANKS - THICKNESS DATA SUMMARY AND ESTIMATES FOR LIFE EXPECTANCY

Tank No. T-109

Design Data

Nominal Capacity	12,000	Gals.
Material of Construction	Carbon	Steel
Year Built - approximate	1981(?)	
Designed Corrosion allowance	0.0625	in.
Specific Gravity	1.5	

Material Thicknesses (inches)	Top	Shell	Cone Bottom	
Per UL-142 Standard	0.123	0.167	0.24	
As Built per Imperial Fabrication Dwg. 1986 = T	0.25	0.313	0.375	
Established Retirement Thickness				
Without Corrosion allowance = A	0.125	0.156	0.25	Per Engineering Report of June
With Corrosion allowance = B	0.156	0.1875	0.281	1995 by Lee Mount

UT Test Data	Top Average	Top Minimum	Shell Average	Shell Minimum	Cone Bottom Average	Cone Bottom Minimum	Testing Service
Year 1989	0.254	0.249	0.315	0.305	0.385	0.384	Alpha Consultant
Year 1991	0.255	0.246	0.318	0.307	0.414	0.397	Sirrine Envn. Consultants
Year 1995							MQS
Year 1996	0.252	0.247	0.305	0.293	0.391	0.37	MQS
Year 1997	0.237	0.218	0.29	0.281	0.377	0.348	CHES
Year 1998	0.235	0.229	0.269	0.222	0.279	0.256	CHES
Year 1999	0.258	0.228	0.355	0.218	0.306	0.268	CHES
Year 2000	0.216	0.215	0.262	0.212	0.271	0.25	CHES
Year 2001	**0.216**	**0.206**	0.264	0.206	0.27	0.25	CHES
Year 2002			0.252	0.218	0.254	0.235	Calumet Testing Service
Year 2003			**0.25**	**0.216**	**0.253**	**0.234**	Calumet Testing Service

	Top		Shell		Cone Bottom	
Lowest Readings						
Average thickness = C	0.216		0.25		0.253	
Test reading = D		0.206		0.216		0.234
Maximum Thickness loss when compared to estimated as-built thickness						
based on lowest average reading = E = (T - C)	0.034		0.063		0.122	
based on lowest test reading = F = (T - D)		0.044		0.097		0.141
Corrosion Rate (2003-1981) over 22 yrs.						
In in/yr = G = E/22	0.0015455		0.002864		0.005545	
In in/yr =H = F/22		0.002		0.004409		0.006409

In Mills/yr.	1.5	2.0	2.9	4.4	5.5	6.4

Life Expectancy						
Based on lowest average reading = (C-B)/G	39		22		0	
Based on lowest test reading = (D-A)/H		41		14		0

Projected year of retirement	**2004**	**2004**

Notes:

1. Estimated actual thickness and estimated retirement thickness are taken form the engineering report by Lee Mount, dated June 19th 1995.
2. Minimum and average thickness are obtained from UT test reports for respective years.
3. Due to the variation in the thickness data, for a conservative approach, a lowest thickness reading per category has been selected to develop a maximum corrosion rate.
4. For uniformity, regardless of year of the lowest reading, the reduction in thickness based on the lowest reading has been assumed to have occurred over the life of the tank.
5. Projected year of retirement has been determined by assuming that the corrosion rate to remain constant as calculated by thickness loss.
6. Corrosion rate and therefore life expectancy have been calculated two ways, one based on lowest average thickness and secondly based on lowest individual reading.

When calculating life expectancy based on lowest average thickness, retirement thickness with corrosion allowance has been used. However, when calculating it based on lowest individual reading, just the minimum retirement thickness has been utilized.

7. After calculating all six possible life expectancies, the retirement year has been established based on the lowest life expectancy of the six.

FUELS TANKS - THICKNESS DATA SUMMARY AND ESTIMATES FOR LIFE EXPECTANCY

Tank No. **T-110**

Design Data

Nominal Capacity	12,000	Gals.
Material of Construction	Carbon	Steel
Year Built - approximate	1981(?)	
Designed Corrosion allowance	0.0625	in.
Specific Gravity	1.5	

Material Thicknesses (inches)	**Top**	**Shell**	**Cone Bottom**	
Per UL-142 Standard	0.123	0.167	0.24	
As Built per Imperial Fabrication Dwg. 1986 = T	0.25	0.313	0.375	
Established Retirement Thickness				
Without Corrosion allowance = A	0.125	0.156	0.25	Per Engineering Report of June
With Corrosion allowance = B	0.156	0.1875	0.281	1995 by Lee Mount

UT Test Data	**Average**	**Minimum**	**Average**	**Minimum**	**Average**	**Minimum**	**Testing Service**
Year 1989	0.251	0.249	0.312	0.303	0.388	0.387	Alpha Consultant
Year 1991	0.23	0.225	0.314	0.31	0.428	0.414	Sirrine Envn. Consultants
Year 1995							MQS
Year 1996	0.22	0.205	0.303	0.3	0.407	0.394	MQS
Year 1997	0.214	0.201	0.295	0.291	0.4	0.397	CHES
Year 1998	0.225	0.2	0.298	0.29	0.399	0.384	CHES
Year 1999	0.252	0.202	0.282	0.208	0.4	0.388	CHES
Year 2000	0.217	0.215	0.298	0.296	0.401	0.388	CHES
Year 2001	**0.213**	**0.198**	**0.282**	**0.23**	0.398	0.386	CHES
Year 2002			0.285	0.279	0.378	0.37	Calumet Testing Service
Year 2003			0.284	0.277	**0.376**	**0.37**	Calumet Testing Service

	Top Average	Top Minimum	Shell Average	Shell Minimum	Cone Bottom Average	Cone Bottom Minimum
Lowest Readings						
Average thickness = C	0.213		0.282		0.376	
Test reading = D		0.198		0.23		0.37
Maximum Thickness loss when compared to estimated as-built thickness						
based on **lowest** average reading = E = (T - C)	0.037		0.031		-0.001	
based on **lowest** test reading = F = (T - D)		0.052		0.083		0.005
Corrosion Rate (2003-1981) over 22 yrs.						
In in/yr = G = E/22	0.0016818		0.001409		NMF	
In in/yr =H = F/22		0.0023636		0.003773		0.000227

In Mills/yr.	1.7	2.4	1.4	3.8	NMF	0.2
Life Expectancy						
Based on lowest average reading = (C-B)/G	34		67		NMF	
Based on lowest test reading = (D-A)/H		31		20		528
Projected year of retirement				**2024**		

Notes:
1. Estimated actual thickness and estimated retirement thickness are taken form the engineering report by Lee Mount, dated June 19th 1995.
2. Minimum and average thickness are obtained from UT test reports for respective years.
3. Due to the variation in the thickness data, for a conservative approach, a lowest thickness reading per category has been selected to develop a maximum corrosion rate.
4. For uniformity, regardless of year of the lowest reading, the reduction in thickness based on the lowest reading has been assumed to have occurred over the life of the tank.
5. Projected year of retirement has been determined by assuming that the corrosion rate to remain constant as calculated by thickness loss.
6. Corrosion rate and therefore life expectancy have been calculated two ways, one based on lowest average thickness and secondly based on lowest individual reading.
When calculating life expectancy based on lowest average thickness, retirement thickness with corrosion allowance has been used. However, when calculating it based on lowest individual reading, just the minimum retirement thickness has been utilized.
7. After calculating all six possible life expectancies, the retirement year has been established based on the lowest life expectancy of the six.

FUELS TANKS - THICKNESS DATA SUMMARY AND ESTIMATES FOR LIFE EXPECTANCY

Tank No. T-112

Design Data

Nominal Capacity	12,000	Gals.
Material of Construction	Carbon	Steel
Year Built - approximate	1981(?)	
Designed Corrosion allowance	0.0625	in.
Specific Gravity	1.5	

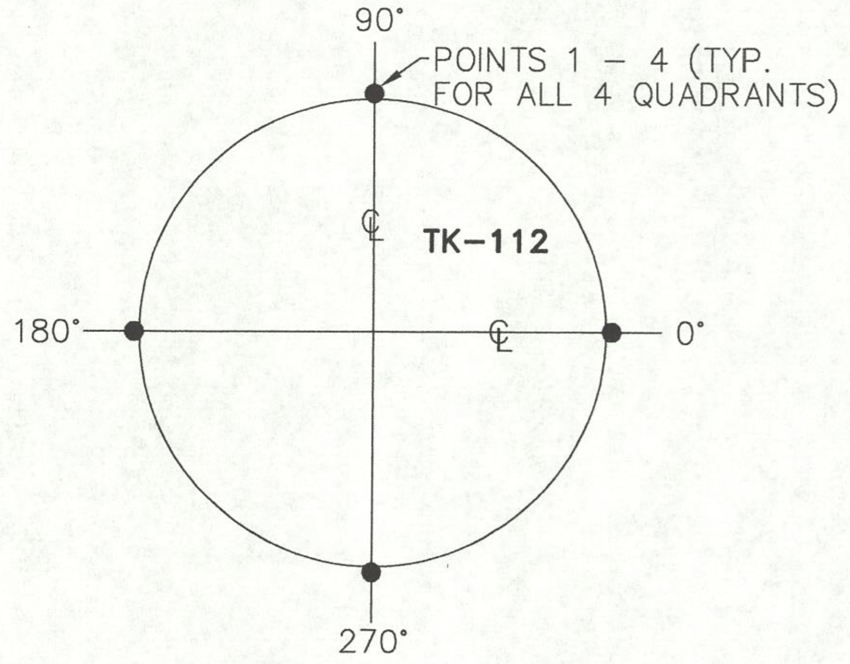
Material Thicknesses (inches)	Top	Shell	Cone Bottom	
Per UL-142 Standard	0.123	0.167	0.24	
As Built per Imperial Fabrication Dwg. 1986 = T	0.25	0.313	0.375	
Established Retirement Thickness				
Without Corrosion allowance = A	0.125	0.156	0.25	Per Engineering Report of June
With Corrosion allowance = B	0.156	0.1875	0.281	1995 by Lee Mount

	Top Average	Top Minimum	Shell Average	Shell Minimum	Cone Bottom Average	Cone Bottom Minimum	Testing Service
Year 1989	0.255	0.242	0.304	0.301	0.375	0.37	Alpha Consultant
Year 1991	0.254	0.25	0.296	0.277	0.401	0.389	Sirrine Envn. Consultants
Year 1995							MQS
Year 1996	0.223	0.203	0.277	0.26	0.379	0.368	MQS
Year 1997	0.217	**0.193**	0.273	0.259	0.377	0.368	CHES
Year 1998	0.215	0.201	0.261	0.245	0.372	0.359	CHES
Year 1999	**0.208**	0.206	0.265	0.248	0.373	0.364	CHES
Year 2000	0.213	0.2	**0.247**	**0.24**	0.368	0.36	CHES
Year 2001	0.222	0.214	0.264	0.246	0.368	0.358	CHES
22-Apr-04			0.263	0.241	**0.36**	**0.355**	Calumet Testing Service

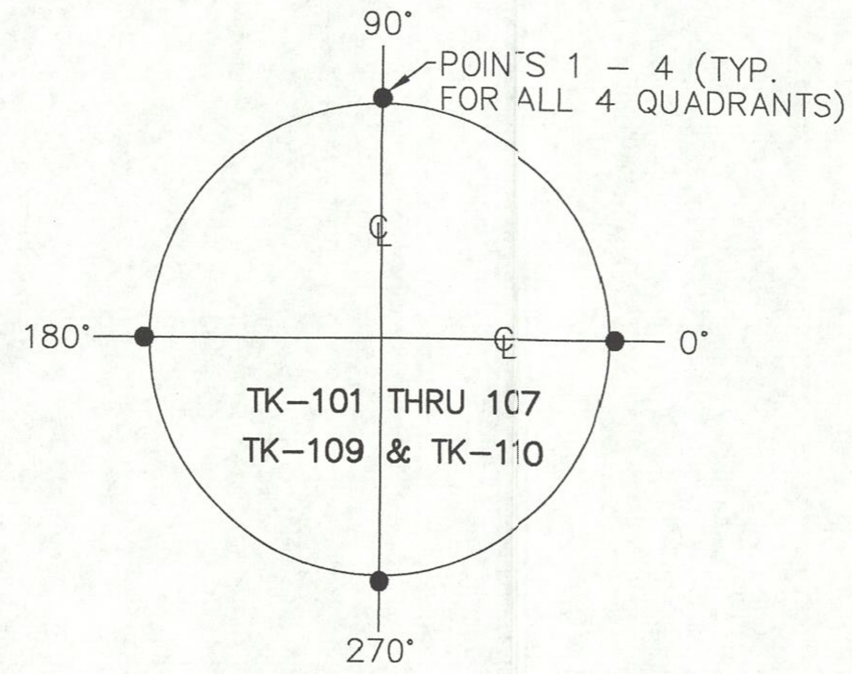
	Top		Shell		Cone Bottom	
Lowest Readings						
Average thickness = C	0.208		0.247		0.36	
Test reading = D		0.193		0.24		0.355
Maximum Thickness loss when compared to estimated as-built thickness						
based on lowest average reading = E = (T - C)	0.042		0.066		0.015	
based on lowest test reading = F = (T - D)		0.057		0.073		0.02
Corrosion Rate (2003-1981) over 22 yrs.						
In in/yr = G = E/22	0.0019091		0.003		0.000682	
In in/yr =H = F/22		0.0025909		0.003318		0.000909

In Mills/yr.	1.9	2.6	3.0	3.3	0.7	0.9
Life Expectancy						
Based on lowest average reading = (C-B)/G	27		20		116	
Based on lowest test reading = (D-A)/H		26		25		116
Projected year of retirement			**2024**			

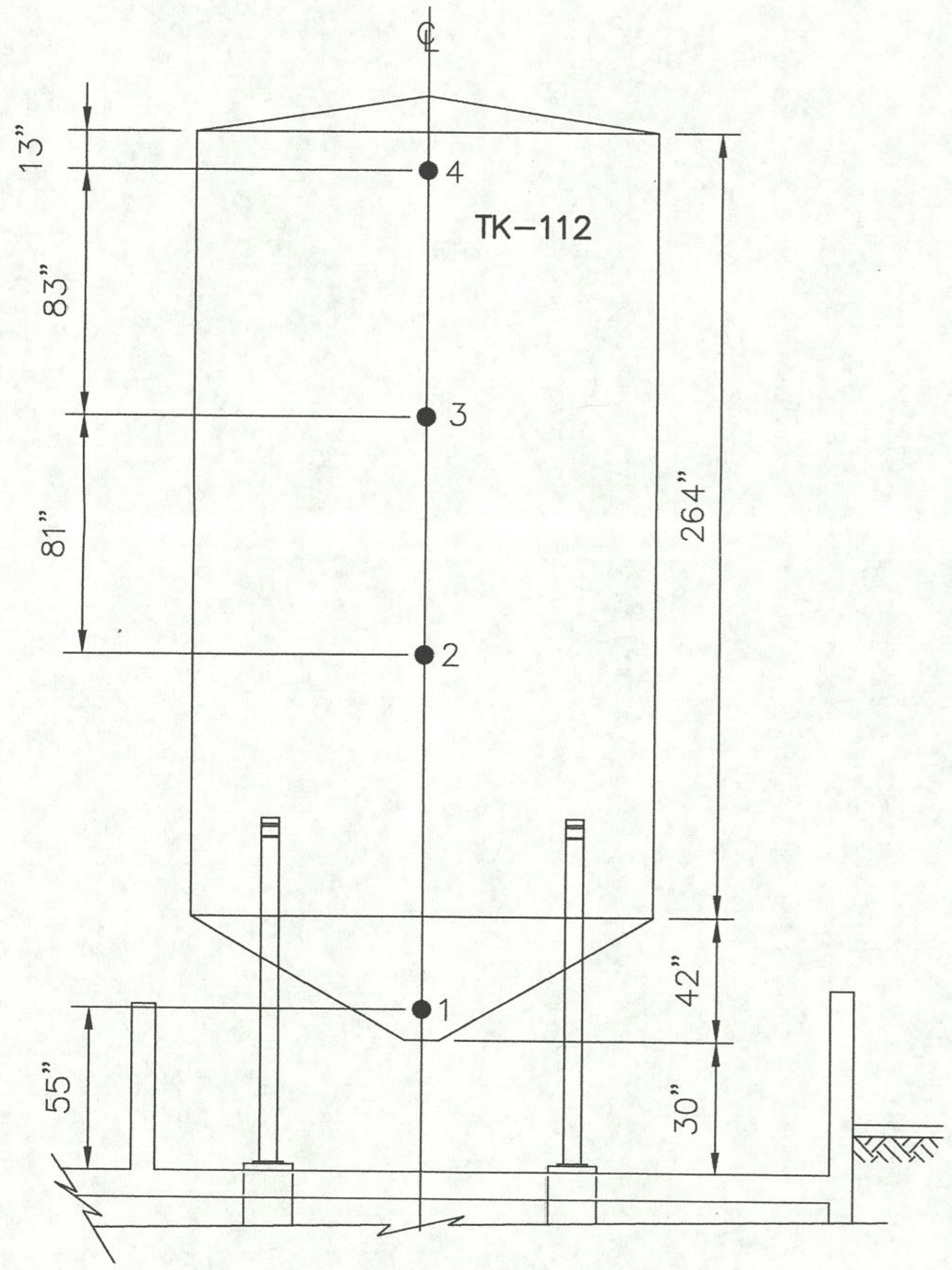
Notes:
1. Estimated actual thickness and estimated retirement thickness are taken form the engineering report by Lee Mount, dated June 19th 1995.
2. Minimum and average thickness are obtained from UT test reports for respective years.
3. Due to the variation in the thickness data, for a conservative approach, a lowest thickness reading per category has been selected to develop a maximum corrosion rate.
4. For uniformity, regardless of year of the lowest reading, the reduction in thickness based on the lowest reading has been assumed to have occurred over the life of the tank.
5. Projected year of retirement has been determined by assuming that the corrosion rate to remain constant as calculated by thickness loss.
6. Corrosion rate and therefore life expectancy have been calculated two ways, one based on lowest average thickness and secondly based on lowest individual reading.
When calculating life expectancy based on lowest average thickness, retirement thickness with corrosion allowance has been used. However, when calculating it based on lowest individual reading, just the minimum retirement thickness has been utilized.
7. After calculating all six possible life expectancies, the retirement year has been established based on the lowest life expectancy of the six.
8. The test data for year 2002 and 2003, specially for bottom cone, appeared to be inaccurate based on in-house internal and external thickness testing of the tank. Calumet Testing was asked to re-test the tank on April 22, 2004. The test results of April 2004 corraborated thicknesses obtained during in-house testing. Therefore, data for the year 2002 & 2003 has not beeen included in the analysis.



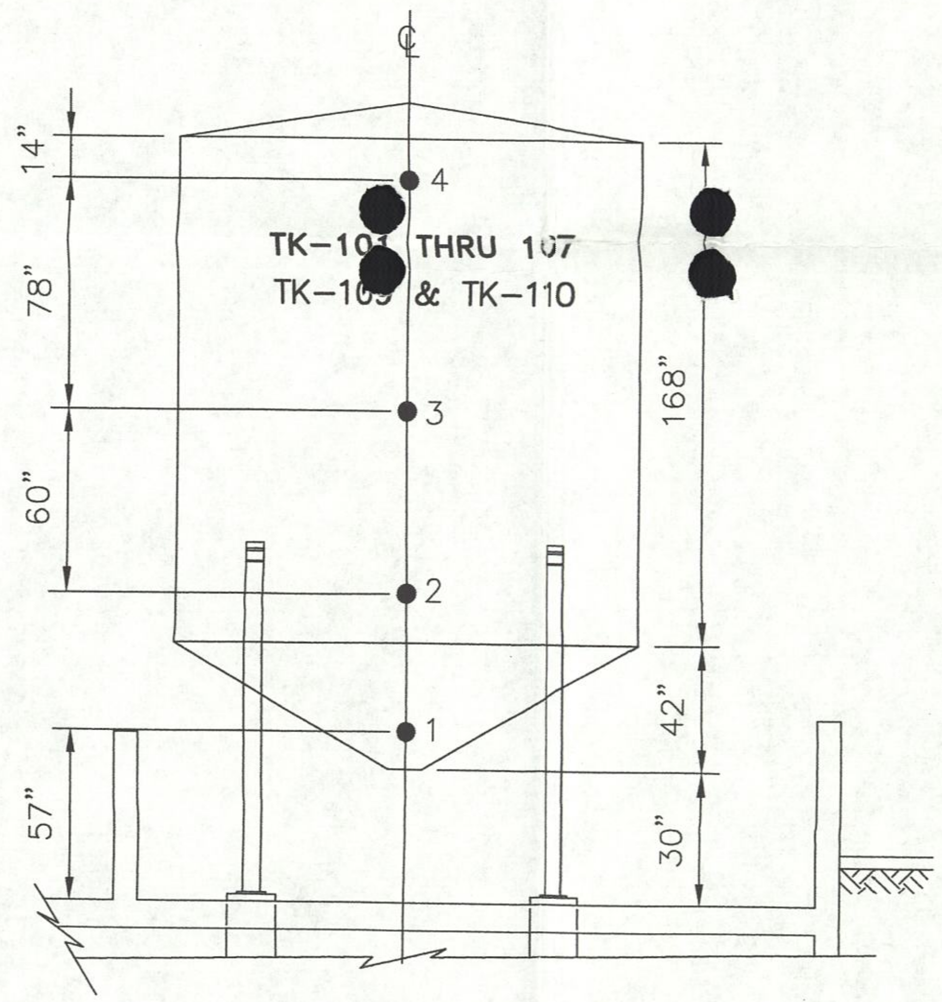
PLAN



PLAN



ELEVATION



ELEVATION

TYPICAL FOR AS NOTED TANKS

CHSI DWG. NO. 4252A

ISSUE	DESCRIPTION	DRWN.	CHKD.	APPR.	DATE
A	SEE REVISION NOTE A	K.M.C.	A.M.L.	A.M.L.	1/30/04

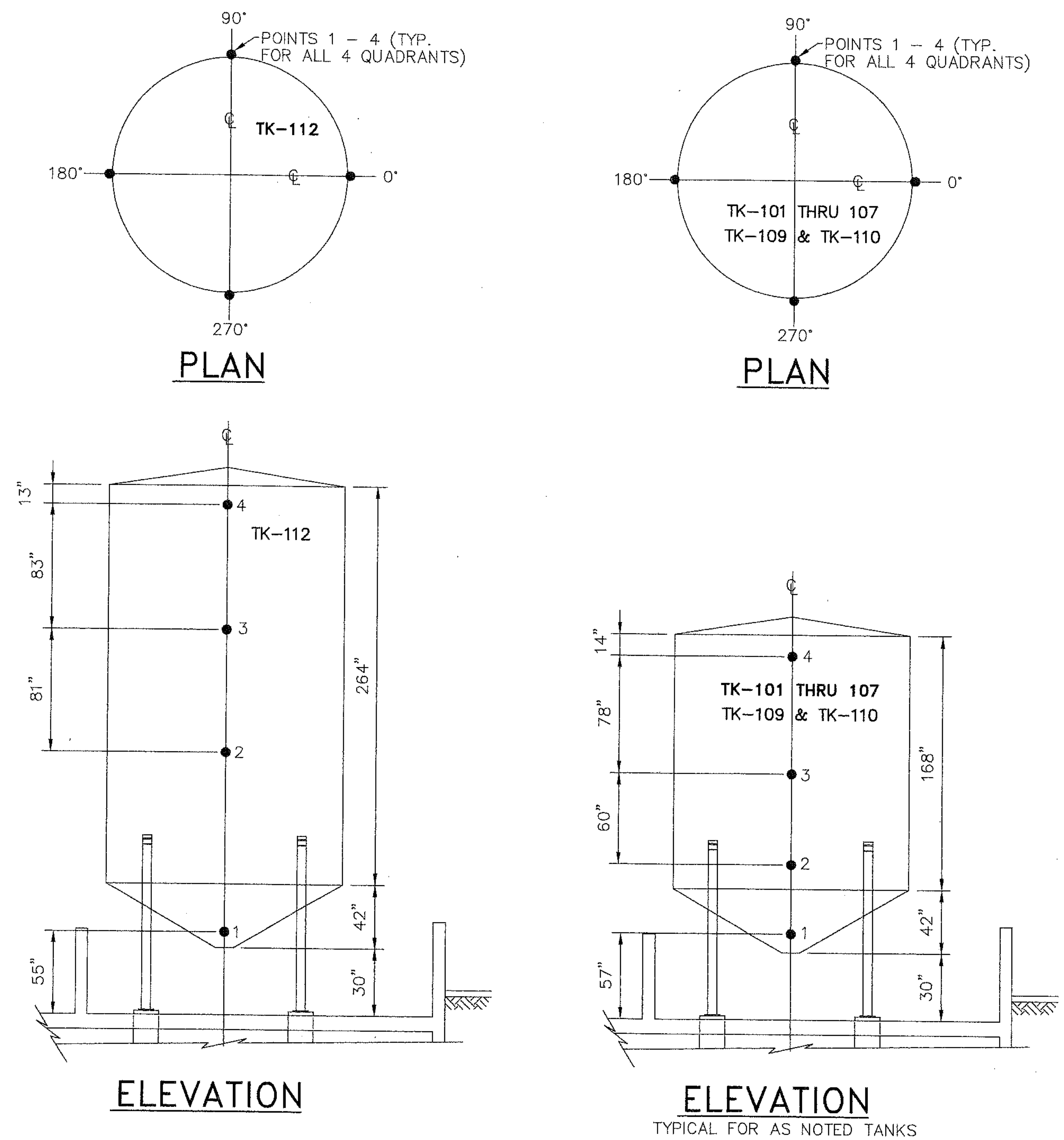
CleanHarbors
ENVIRONMENTAL SERVICES, INC.
1501 Washington Street
Braintree, Massachusetts 02185
Telephone (781) 849–1800

TITLE
CLEAN HARBORS SERVICES, INC.
11800 S. STONY ISLAND AVENUE
CHICAGO, ILLINOIS 60617

ULTRASONIC TEST POINT LOCATIONS
FOR TANK FARM UNIT #16

PROJECT NO. CH114630
DRAWING NO. 4630–M–23
SCALE 3/16"=1'–0"

REV.#	REVISION NOTES
A	ULTRASONIC TEST POINT LOCATIONS



CHSI DWG. NO. 4252A

ISSUE	DESCRIPTION	DRWN.	CHKD.	APPR.	DATE
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REV.#	REVISION NOTES
A	ULTRASONIC TEST POINT LOCATIONS

PROJECT NO. CH114630
SCALE 3/16"=1'-0"
DRAWING NO. 4630-M-23

Appendix D-60
Lamp Crushing Machine

POTENTIAL PATHWAYS OF EXPOSURE TO HUMANS OR ENVIRONMENTAL RECEPTORS

CHSI believes that operating the lamp crushing system will present the same minimal level of potential exposure to humans and the environment as other operations at the facility (e.g., waste consolidation, waste stabilization, fuels blending, lab pack pour off, bulk liquid flammable tank farm, truck loading/unloading pad, hazardous waste shredding system, metalwashing system, etc.). A number of factors significantly minimize any potential exposure of on-site and off-site personnel or the environment to hazardous and non-hazardous waste lamps processed in the operation. These factors and the types of material to be managed and the potential exposure pathways, environmental receptors and magnitude and nature of exposures are discussed below.

(1) WASTES TO BE MANAGED

CHSI will use the Lamp Crushing System to manage hazardous and non-hazardous waste lamps. CHSI receives material such as fluorescent, mercury-vapor, metal-halide and high-pressure sodium lamps other inorganic materials. These materials will contain a variety of inorganic compounds including mercury, barium, cadmium, lead and sodium. The types of chemical constituents and their concentrations will vary based on the type of lamp that is managed.

There is minor variability in the types of lamps to be managed and their concentrations. For the purposes of this document, CHSI assumed a "worst case" scenario. The assumptions that were made include:

* Inorganic materials to be managed in the unit would be similar to those lamp wastes already being managed in CHSI's on going storage operations;

* Lamps to be managed would consist primarily of inorganic compounds including heavy metals, glass, and calcium phosphate powder. In general, mercury would be more toxic than other organic or inorganic constituents thereby presenting a worst case scenario when considering the potential impacts associating with inhalation;

* CHSI used the results of an analysis performed by Shaw Environmental, Inc. (Compliance Test Report, Fluorescent Bulb Crusher, Clean Harbors Environmental Services, Inc. Facility, Cincinnati, Ohio) as part of its assessment of potential off-site air impacts. As part of Shaw's assessment, it assumed mercury and particulate are present in typical on-site operations;

* Potential pathways and impacts considered normal operation of the unit and spill events; and

* Industrial Hygiene Exposure Monitoring conducted by Clean Harbors Environmental Services, Inc. at the Cincinnati, Ohio facility on the Lamp Recycling System. As part of the assessment, it assumed mercury and particulate are present in typical on-site operations.

(2) POTENTIAL PATHWAYS OF HUMAN EXPOSURE

CHSI considered three (3) different scenarios when assessing potential human exposures: (1) on-site worker operating/working crushing operations; (2) on-site worker working immediately outside the operating areas; and (3) person located off-site.

The typical potential pathways of human exposure for this activity could include:

* Absorption of inorganic material through direct contact with the skin, eyes, etc. (direct absorption) or absorption by contact with inorganic (indirect absorption)

* Ingestion of inorganic material (direct ingestion) or ingestion of soil, groundwater or surface water contaminated with inorganic (indirect ingestion)

* Inhalation of vapors and particulate associated with the management of inorganic materials

These human exposure pathways were evaluated for each of three (3) scenarios. The results of this assessment are provided below.

(A) On-site Worker at the Lamp Crusher

Absorption

Like the waste management activities already taking place at CHSI, all employees working at the lamp crushing operations will wear the appropriate personnel protective equipment (PPE) for the materials being managed and the operations to be performed. This equipment will include: hard hat; steel toed shoes; chemical resistant apron; Kevlar sleeves; cut proof outer gloves (e.g., Kevlar) with Nitrile inner gloves; hearing protection and half-face, cartridge respirator with face shield or full face, cartridge respirator (Mersorb-P100 cartridges or equivalent).

All moving parts of the crusher are enclosed, making the unit safe to operate.

Using the appropriate PPE and following CHSI's existing standard operation procedures for donning and doffing PPE and personal and equipment decontamination will prevent or significantly minimize any worker exposure to or contact with inorganic materials to be managed in the crushing operations via absorption pathways. In the unlikely event inorganic materials came into contact with an employees' skin, eyes, etc., the employee would immediately wash/flush the affected area with water and/or and appropriate cleaner (e.g., soap). The employee would then be directed to seek proper medical attention off-site, if appropriate.

In addition to contact with inorganic material during normal, routine activities associated with operating the lamp crushing system, contact during non-routine activities (i.e., spills) must also be considered. In the event of a spill of inorganic material within the building, the spill will be cleaned up by personnel wearing the appropriate PPE to minimize the potential for contact with contaminants.

Ingestion

All workers involved with hazardous waste management activities have been trained in hazardous waste operations, the appropriate use of PPE, the proper means of PPE, equipment and personal decontamination. Because of this, the chance for exposure either through direct ingestion of inorganic materials is extremely unlikely to non-existent.

Since the crushing operation will be located within an enclosed building the possibility of a worker ingesting an environmental media (e.g., soil, groundwater, surface water) contaminated with inorganic material is non-existent. The lamp crusher is located in an imperviously-coated containment area. This would also restrict the possibility of a worker ingesting and environmental media. In addition to wearing the appropriate PPE and personal decontamination, eating, chewing gum or tobacco, and smoking cigarettes is restricted to designated areas on-site thereby significantly reducing any possibility for a worker to indirectly ingest contaminants.

Inhalation

A full face respirator equipped with cartridges specifically selected for the types of materials being managed or a half-face respirator with face shield will protect crusher workers from potential inhalation exposure. In addition to PPE, CHSI will also use institutional controls to limit the accumulation of inorganic vapors and particulate in the immediate area surrounding the lamp crushing operation.

Fugitive emissions from these operations will be vented to a particulate filter followed by activated carbon. According to the carbon manufacturer, these units will remove nearly 100% of the mercury from the vented air prior to discharge to the atmosphere through a stack until breakthrough occurs (see discussion on carbon units in (2)(B), below).

The combination of wearing the appropriate respirator, using the appropriate respirator cartridges and removal of fugitive emissions will prevent and/or significantly minimize worker exposure to inorganic vapors and particulate.

The results of an analysis performed by Shaw Environmental, Inc. (Compliance Test Report, Fluorescent Bulb Crusher, Clean Harbors Environmental Services, Inc. Facility, Cincinnati, Ohio) show average particulate emissions of 0.0020 pounds per hour and average mercury emissions of 0.0000075 pounds per hour during lamp crushing operations. These emissions are low and well within required criteria.

Industrial Hygiene Exposure Monitoring was conducted by Clean Harbors Environmental Services, Inc. at the Cincinnati, Ohio facility on employees during lamp crushing activities. All full shift exposure levels were low and well within current occupational exposure level criteria.

(B) On-site Worker Outside Unit 25

Absorption/Ingestion

Because lamp crushing operations will take place within secondary containment in an enclosed building, the only means for personnel working outside this unit to come into contact with inorganic material would be in the event of a spill or release. Building 25 alkaline bay will provide approximately 7,871 gallons of secondary containment. As a result of the potential for a spill of inorganic material to escape Building 25 is minimal. Spill clean up personnel would wear PPE appropriate to the material spilled to minimize the potential for contact with spilled material and clean up debris.

Inhalation

Personnel working outside these units could potentially come into contact with inorganic materials by inhalation. As previously discussed, the area in which lamp crushing operations occur is ventilated and vapors and particulate from the operation is vented to a particulate filter and activated carbon. Removal of particulates from a particulate filter and mercury vapors in air using carbon are recognized air pollution control technologies that are utilized in many industrial and commercial applications. CHSI currently operates several particulate filters and carbon units to control emissions from a number of on-site operations. These units have been permitted by the Illinois Environmental Protection Agency.

According to the carbon vendor, the carbon will continue to remove close to 100% of the mercury vapors from the ventilated air until breakthrough occurs. Once breakthrough of the carbon occurs, the removal efficiency of the carbon for mercury will decrease.

Carbon breakthrough will be determined by monitoring the mercury concentrations in air at the inlet and outlet points of the carbon unit using a direct reading mercury vapor monitoring device. Breakthrough will be determined when the carbon unit approaches a 95% mercury removal efficiency.

In the event breakthrough of the carbon canister, the canister will be removed and replaced with a canister of fresh carbon.

CHSI believes that operating the air pollution control units will prevent any exposure to workers to particulate and mercury vapors emitted from lamp crushing operations.

The results of an analysis performed by Shaw Environmental, Inc. (Compliance Test Report, Fluorescent Bulb Crusher, Clean Harbors Environmental Services, Inc. Facility, Cincinnati, Ohio) show average particulate emissions of 0.0020 pounds per hour and average mercury emissions of 0.0000075 pounds per hour during lamp crushing operations. These emissions are low and well within required criteria.

Industrial Hygiene Exposure Monitoring was conducted by Clean Harbors Environmental Services, Inc. at the Cincinnati, Ohio facility on employees outside the operation during lamp crushing activities. All full shift exposure levels were low and well within current occupational exposure level criteria.

(C) Potential Exposure Pathways to Off-Site Personnel

Absorption/Ingestion

Because the CHSI facility is a secure facility (e.g., fences and gates restricting access), the potential for direct or indirect exposure of off-site personnel to inorganic materials through absorption is extremely unlikely to non-existent.

The potential for ingestion of inorganic material by off-site personnel is also extremely unlikely. The unit will be located within the secure facility within an area equipped with impervious secondary containment in an enclosed building. The area surrounding the unit will be inspected daily for spills and releases. All spills will be cleaned up immediately upon detection. As a result, the potential for spills of inorganic material to exit the containment is very unlikely. In the unlikely event organic material escaped secondary containment, CHSI personnel would immediately cleanup any spilled material thereby minimizing the impact, if any, to the environment. Impervious secondary containment and immediate cleanup of spills would make the significantly limit the potential for groundwater contamination caused by operating the unit. Since the nearest drinking water well is located approximately three (3) miles from the facility, the potential for someone to drink water contaminated by a release form the unit is extremely unlikely to non-existent.

Inhalation

As discussed in Section (B), above, emissions from lamp crushing operations will be vented through particulate filters and carbon prior discharge to the atmosphere. The units are designed and will be operated to remove up to 100% of the particulates and mercury vapors prior to its discharge to the atmosphere. The carbon units will be monitored and replaced when breakthrough occurs.

The results of an analysis performed by Shaw Environmental, Inc. (Compliance Test Report, Fluorescent Bulb Crusher, Clean Harbors Environmental Services, Inc. Facility, Cincinnati, Ohio) show average particulate emissions of 0.0020 pounds per hour and average mercury emissions of 0.0000075 pounds per hour during lamp crushing operations. These emissions are low and well within required criteria.

As part of CHSI's RCRA Part B permit application, Carlson Environmental, Inc. performed and analysis titled "Evaluation of Potential Hazardous Material Emergencies through atmospheric Transport from the Current and Proposed Clean Harbors Facility, Chicago, Illinois" (see Appendix 7-A). According to that analysis, the land use in the immediate vicinity of the CHSI facility is heavy industrial. Land surrounding use the facility and some potential receptors are listed below:

* 0.5 miles from the CHSI facility
  North - Undeveloped recreational areas
  South - EmEs Company, Lake Calumet Slip #2
  East - Land and Lake Landfill
  West - Lake Calumet

* 1.0 miles from the CHSI facility
  North - North turning basin of Lake Calumet,
  undeveloped recreational areas
  South - Lake Calumet, bulk terminal plant
  East - Land and Lake Landfill, Norfolk & Western Railway
  West - Calumet Expressway

* 1.5 miles from the CHSI facility
  North - Undeveloped recreational areas
  South - 130th Street, rail yard
  East - Rail yard
  West - Arcade Park residential area, rail yard

* 2.0 miles from the CHSI facility
  North - Stony Island Expressway, 103rd Street
  South - Beaubien Woods Forest Preserve, Carver Area High
  East - Calumet Fiver, Buffalo Street
  West - Palmar Park residential areas, St. Martin de Porres High School

The predominant wind direction is to the south. The nearest sensitive receptors (e.g., schools, hospitals) to the CHSI facility are located approximately two (2) miles away. Due to the nature of the materials managed and the air pollution control system that will be in place, the potential adverse impact to a person off-site from lamp crushing activities is non-existent. The potential off-site inhalation impact to humans associated with a "worst case" spill (i.e., containment) is extremely unlikely to non-existent.

(3) POTENTIAL ENVIRONMENTAL RECEPTORS

There are four (4) potential contaminant migration pathways: soils, groundwater, surface water, and air. Environmental receptors would include aquatic life in Lake Calumet and birds.

Because lamp crushing activities will occur within an area equipped with impervious secondary containment in an enclosed building and because this area will be inspected on a daily basis for spills/released, the potential for spills/releases of inorganic material to enter the soil and groundwater is extremely minimal. As a result, any impact to aquatic life in Lake Calumet from groundwater impacts from lamp crushing activities would also be extremely unlikely to non-existent.

The potential for direct contamination of Lake Calumet from spills or releases of inorganic material is non-existent due to the containment provided by these units and the proximity of these units in relation to the lake.

Emissions from lamp crushing activities would be treated prior to discharge through a stack. As previously discussed, due to the removal efficiency of the particulate filters and carbon, impacts to on-site birds (including sea gulls) are also considered extremely unlikely to non-existent. CHSI believes that these operations pose no greater risk than other activities currently permitted and taking place on-site.

The results of an analysis performed by Shaw Environmental, Inc. (Compliance Test Report, Fluorescent Bulb Crusher, Clean Harbors Environmental Services, Inc. Facility, Cincinnati, Ohio) show average particulate emissions of 0.0020 pounds per hour and average mercury emissions of 0.0000075 pounds per hour during lamp crushing operations. These emissions are low and well within required criteria.

Appendix 7-B contains a document titled "Environmental Assessment Report" prepared by Carlson Environmental, Inc. as part of CHSI's RCRA Part B permit application. This report contains an assessment of potential off-site environmental impacts associated with operation of the CHSI facility.

(4) POTENTIAL MAGNITUDE AND NATURE OF EXPOSURES

Workers in Unit 25 have the greatest potential for exposure to the inorganic materials to be managed. The proper use of PPE and in place engineering controls (e.g., respiratory protection, ventilation and treatment of fugitive emissions associated with the operations will significantly minimize any risk for potential exposure to the chemicals being managed.

In the event a worker is exposed to inorganic materials, either through dermal contact, inhalation, or ingestion CHSI will follow the procedures currently in place for responding to worker exposure to chemicals. These procedures include, but are not limited to: (1) flushing the affected areas as may be appropriate using on-site showers/eyes washes; (2) providing any other first aid that might be appropriate; and (3) sending the worker to a local hospital for examination and/or treatment.

Impacts associated with other on-site and off-site personnel and impacts to the environment are considered extremely minimal and would have no more impact than other waste management activities currently taking place at the facility.

Industrial Hygiene Exposure Monitoring
Spring Grove Resource Recovery
Lamp Recycling System

Summary

In July 2003, a set of employee exposure monitoring samples was collected from personnel working at the Spring Grove Resource Recovery (SGRR) Lamp Recycling System (LRS) and receiving areas adjacent to the LRS. Samples were collected to assess exposure to inorganic mercury and noise during routine operations. Five employees (Shana Shaffer, Jeff Davison, Mike Fultz, John Heiert, and Phil Sterchi) were selected for airborne mercury sampling. Jeff Davison and Shana Shaffer were also selected for noise exposure monitoring. Airborne mercury sampling results showed levels below the established ACGIH TLV and OSHA PEL (0.025 mg/m^3 and 0.1 mg/m^3 respectively), and all within the protective limitations of the personal protective equipment worn by the employees: including that which is worn by LRS operations personnel and the receiving operation occurring adjacent to the LRS. Noise exposure monitoring showed levels under the OSHA PEL of 90 dB. Recommendations for follow-up actions include: 1) conduct periodic sampling to measure specifically for inorganic mercury in order to gather additional data with the intent to verify that the proper personal protective equipment specified for the operations monitored is adequate, 2) evaluate the necessity of a lateral ventilation system on feed conveyor #1 that may allow a downgrade of personal protective equipment to a modified level D.

Operations Overview

CHES personnel provide treatment, storage, and disposal services for this facility. The operations involved in this IH survey include the Lamp Recycling System and the receiving operations at Spring Grove Resource Recovery.

The Lamp Recycling System segregates all components of various sized fluorescent lamps, HID lamps, etc. and prepares them for recycling. Lamps are fed into one of two areas, either a conveyor (for 4ft. and 8ft. lamps) or a "crusher box" (for HID lamps). Once the lamps are fed into the machine, the glass, phosphor powder (mercury containing), and metal parts are segregated using vibrating mesh conveyors, magnets, and air movement. The filtration system in the unit is designed to filter the particulate phosphor and the mercury vapor with a series of high efficiency particulate air filters and activated charcoal. This filtration system allows very little mercury vapor to be dispelled out of the machine via lamp part outlets (chutes). The unit is also under constant negative pressure, reducing the opportunity for mercury vapor to escape the closed system. The most prevalent release point for mercury vapor is at the operation point at feed conveyor #1, where the operators load the lamps. Occasionally, the lamps arrive at the facility already broken in the boxes during shipment, making exposure possible. Also, if the lamps are fed incorrectly (e.g. stacked higher than the guard on feed conveyor #1) the bulbs break before entering the machine allowing the mercury containing phosphor powder to be released prior to the ventilation system. In addition to the engineering controls, operators are in level C personal protective equipment which includes a CPF I apron, half face APR with Mersorb P100 cartridges, and cut resistant outer gloves with Kevlar sleeves.

The receiving operation takes place adjacent to the LRS. It includes staging containers (loading/off-loading trailers) and sampling of those containers by receiving chemists. The receiving personnel were included in this IH survey due to the close proximity to the LRS operation. The individuals sampled were primarily operating a fork lift loading/off-loading trailers and staging containers for the receiving chemists. The path the fork truck operators take brings them within 10-15 ft. of the LRS. The samples taken served to verify the direct reading results that had demonstrated that mercury vapor did not spread into the receiving area.

Sampling Procedure

Three employees (Shana Shaffer, Jeff Davison, Mike Fultz, John Heiert, and Phil Sterchi) were selected for assessment. All five employees were equipped with an SKC Badge 520 – 02A + capsule holder with a charcoal disk (520 – 03) at the start of their work shift, and these remained on throughout the day. Galson

Laboratories, Syracuse NY, analyzed the samples for mercury vapor in accordance with Occupational Safety and Health Administration methods (OSHA ID-140). Airborne concentrations were also measured using a Lumex mercury vapor analyzer. Results showed levels ranging from 8000 – 25,000 ng/m^3 in the operators breathing zone.

Results/Discussions

Sample results are presented in the accompanying tables. All full shift exposure levels were low and well within current occupational exposure level criteria. All concentrations were also well within the protection factor of the respirator being worn (Half mask Air Purifying Respirator) and the hearing protection being utilized. Sound level measurements were collected in several areas around the LRS and are shown in Diagram 1.

Recommendations

The following recommendations are made based on these results:

1. Conduct periodic sampling to measure specifically for inorganic mercury in order to gather additional data with the intent to verify that the proper personal protective equipment specified for the operations monitored is adequate;
2. Evaluate the necessity of a lateral ventilation system that may allow a downgrade of personal protective equipment to a modified level D.

Report Prepared by:

Mitchell A. Pence
Clean Harbors Environmental Services
Health and Safety Manager

Report Reviewed by:

Mark R. Arriens, MS, CIH, CSP
Clean Harbors Environmental Services
Director, Health and Safety

CHESI EXPOSURE MONITORING RESULTS

Lamp Recycling System

Employee / Location	Date / Total Sampling Time	Sample #	Analysis conducted	SAMPLING RESULTS- CONCENTRATION (ppm OR mg/m^3)	OEL (ppm OR mg/m^3)	% of OSHA PEL or ACGIH criteria (whichever is less)
Shana Shaffer - LRS operator	7/11/2003 475 min.	71103-01	mercury	0.016 mg/m3	.025 (TLV)	64.00%
Phil Sterchi - LRS operator	7/11/2003 472 min.	71103-02	mercury	0.019 mg/m3	.025 (TLV)	76.00%
Jeff Davison - LRS operator	7/14/2003 388 min.	71103-02	mercury	0.009 mg/m3	.025 (TLV)	36.00%
Mike Fultz - receiving -- lodd/unload trailers	7/14/2003 380 min.	71103-03	mercury	<0.01 mg/m3	.025 (TLV)	<4.00%
Shana Shaffer - LRS operator	7/14/2003 389 min.	71403-01	mercury	0.011 mg/m3	.025 (TLV)	44.00%
Shana Shaffer - LRS operator	7/16/2003 501 min.	71603-01	mercury	0.021 mg/m3	.025 (TLV)	84.00%
Jeff Davison - LRS operator	7/16/2003 500 min.	71603-02	mercury	0.019 mg/m3	.025 (TLV)	76.00%
John Heiert - receiving -- load/unload trailers	7/16/2003 495 min.	71603-03	mercury	<0.01 mg/m3	.025 (TLV)	<4.00%
Jeff Davison - LRS operator	7/14/2003 377 min.	N/A	noise	85.3 dB	90 dB	95.00%
Shana Shaffer - LRS operator	7/16/2003 501 min.	N/A	noise	88.0 dB	90 dB	98.00%
Jeff Davison - LRS operator	7/21/2003 486 min.	N/A	noise	89.0 dB	90 dB	99.00%

ppm - parts per million

mg/m^3 - milligrams/cubic meter

OEL - Occupational Exposure Limit - this denotes the lower of the OSHA or ACGIH exposure criteria. Clean Harbors uses the lower (more protective) of these values.

STEL- Short Term Exposure Limit - this denotes an airborne concentration as measured over a 15 minute time period w/out use of respiratory equipment.

The ACGIH specifies that excurisons above the STEL should not occur more than 4 times per day and there should be at least 60 minutes between successive excursions.

C or Ceiling limit - this denotes an airborne concentration not to be exceeded for any time period in an 8 hour work shift.

Sound Level Meter readings around the LRS:

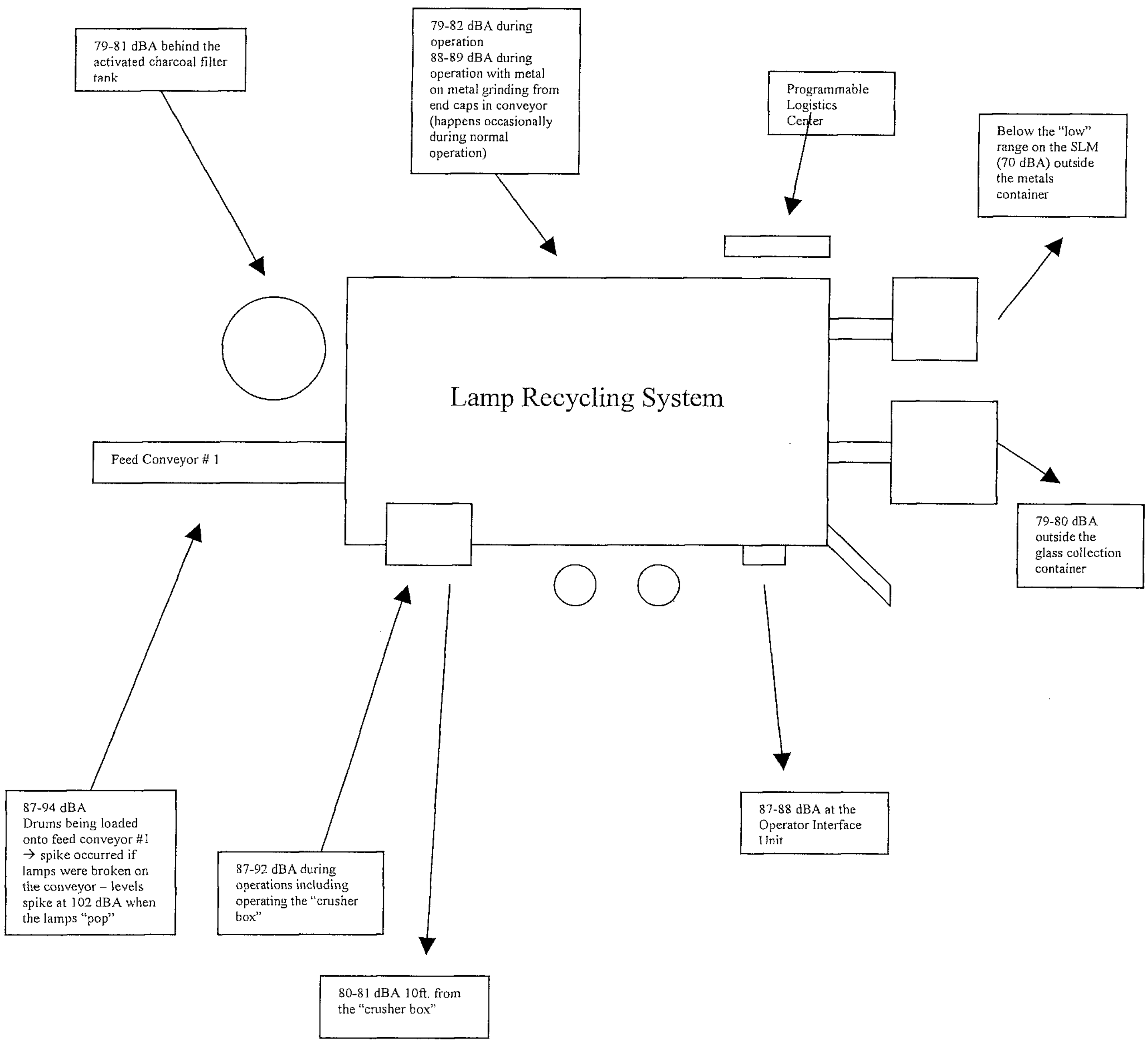

Diagram 1
Sound Level Measurements Around LRS Equipment

MECA ENGINEERING CORP. OF AMERICA

5539 Indianapolis Blvd. East Chicago, IN 46312 (219) 397-0100 FAX(219) 397-0164 e-mail meca.eng@sbcglobal.net

August 31, 2004

Mr. Mark A. Schollenberger, P.E.
Bureau of Land - Permit Section
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, IL 62702

RE: Clean Harbors Services, Inc.
11800 S. Stony Island Avenue
Chicago, IL 60617
Part B Class 3 Permit Modification
Addition of Lamp Crushing Machine for Building 25

Dear Mr. Schollenberger:

I have reviewed the Application for Class 3 permit modification for the lamp crushing machine for Building 25 (Model LSS1, Resource Technology, Inc.). I find the unit is fit for its intended use.

I hereby certify that I, the undersigned am a Professional Engineer, licensed to practice in the State of Illinois in accordance with Ill. Rev. State., par. 5101, Sec. 1 and par. 5119, Sec. 13.1.

I certify under penalty of law that this document and all attachments were prepared under my direct supervision and in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person who manages the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Respectfully submitted,

Kenneth D. Spaulding, P.E.

Kenneth Spaulding

KENNETH D. SPAULDING
62-44249
REGISTERED
PROFESSIONAL
ENGINEER
STATE OF ILLINOIS

4879 Spring Grove Avenue
Cincinnati, Ohio 45232

August 20, 2004

RE: Lamp Crushing Machine

James Laubsted
Environmental Compliance Manager
Clean Harbors Environmental Services, Inc.
11800 South Stoney Island Avenue
Chicago, Illinois 60617

Dear Mr. Laubsted,

I have reviewed the accompanying dispersion calculation for potential mercury air emissions during operation of the Lamp Crushing Machine at the South Stoney Island facility. The calculation, based on stack sampling conducted by Shaw Environmental, estimated a concentration of .00024 micrograms of mercury per cubic meter at a distance of one mile (1609 meters) from the facility and an estimated maximum concentration of .00064 micrograms of mercury per cubic meter at a distance of 274 yards (300 meters) from the facility. Both of these values are well below accepted background ambient air levels that are considered to be safe to the public. The Agency for Toxic Substances and Disease Registry (ATSDR), an agency within the Department of Health and Human Services, has reported in their March 1999 Toxicological Profile for Mercury that normal ambient air background levels of Mercury are as high as .01 to .02 micrograms of mercury per cubic meter. These levels are considered several magnitudes lower than currently acceptable safe concentrations and, when used to compare concentrations computed from the dispersion calculation, it is reasonable to conclude that there are no acute or chronic health effects due to mercury that should be anticipated among nearby residents from the Lamp Crushing Machine operations.

If you have any questions or additional concerns, please contact me at our Spring Grove facility in Cincinnati, Ohio.

Thank you,

William J. Hetrick, CIH
Director of Industrial Hygiene
Clean Harbors Environmental Services, Inc.

wjh

THE AMERICAN BOARD OF INDUSTRIAL HYGIENE
INCORPORATED
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EXPIRES
6-1-2008
PENNSYLVANIA
WILLIAM J. HETRICK

08/11/04
10:54:51

```
 *  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 96043 ***
```

Clean Harbors Chicago Facility Mercury Dispersion Calculation

```
SIMPLE TERRAIN INPUTS:
   SOURCE TYPE              =        POINT
   EMISSION RATE (G/S)      =     .945800E-06
   STACK HEIGHT (M)         =       7.6000
   STK INSIDE DIAM (M)      =        .2026
   STK EXIT VELOCITY (M/S)=        11.7600
   STK GAS EXIT TEMP (K)    =     293.0000
   AMBIENT AIR TEMP (K)     =     293.0000
   RECEPTOR HEIGHT (M)      =        .0000
   URBAN/RURAL OPTION       =        RURAL
   BUILDING HEIGHT (M)      =        .0000
   MIN HORIZ BLDG DIM (M)   =        .0000
   MAX HORIZ BLDG DIM (M)   =        .0000

THE REGULATORY (DEFAULT) MIXING HEIGHT OPTION WAS SELECTED.
THE REGULATORY (DEFAULT) ANEMOMETER HEIGHT OF 10.0 METERS WAS ENTERED.


BUOY. FLUX =     .000 M**4/S**3;  MOM. FLUX =    1.419 M**4/S**2.

*** FULL METEOROLOGY ***

**********************************
*** SCREEN AUTOMATED DISTANCES ***
**********************************

*** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
100.	.5664E-03	2	1.0	1.0	320.0	14.75	19.37	10.80	NO
200.	.5319E-03	4	1.5	1.5	480.0	12.37	15.62	8.61	NO
300.	.6479E-03	5	1.0	1.0	10000.0	13.30	16.97	8.85	NO
400.	.5954E-03	5	1.0	1.0	10000.0	13.30	22.07	10.93	NO
500.	.6356E-03	6	1.0	1.0	10000.0	12.79	18.03	8.53	NO
600.	.6156E-03	6	1.0	1.0	10000.0	12.79	21.29	9.80	NO
700.	.5686E-03	6	1.0	1.0	10000.0	12.79	24.50	11.03	NO
800.	.5140E-03	6	1.0	1.0	10000.0	12.79	27.67	12.07	NO
900.	.4631E-03	6	1.0	1.0	10000.0	12.79	30.81	13.07	NO
1000.	.4175E-03	6	1.0	1.0	10000.0	12.79	33.92	14.03	NO
1100.	.3779E-03	6	1.0	1.0	10000.0	12.79	36.99	14.89	NO
1200.	.3434E-03	6	1.0	1.0	10000.0	12.79	40.04	15.73	NO
1300.	.3134E-03	6	1.0	1.0	10000.0	12.79	43.07	16.54	NO
1400.	.2872E-03	6	1.0	1.0	10000.0	12.79	46.07	17.32	NO
1500.	.2642E-03	6	1.0	1.0	10000.0	12.79	49.05	18.09	NO
1600.	.2440E-03	6	1.0	1.0	10000.0	12.79	52.02	18.84	NO
1700.	.2261E-03	6	1.0	1.0	10000.0	12.79	54.96	19.57	NO
1800.	.2101E-03	6	1.0	1.0	10000.0	12.79	57.89	20.29	NO
1900.	.1959E-03	6	1.0	1.0	10000.0	12.79	60.80	20.99	NO
2000.	.1832E-03	6	1.0	1.0	10000.0	12.79	63.69	21.68	NO

MAXIMUM 1-HR CONCENTRATION AT OR BEYOND 100. M:

301.	.6479E-03	5	1.0	1.0	10000.0	13.30	17.08	8.89	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
*** SCREEN DISCRETE DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
1605.	.2430E-03	6	1.0	1.0	10000.0	12.79	52.16	18.88	NO

DWASH= MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

****
*** SUMMARY OF SCREEN MODEL RESULTS ***
****

CALCULATION PROCEDURE	MAX CONC (UG/M**3)	DIST TO MAX (M)	TERRAIN HT (M)
SIMPLE TERRAIN	.6479E-03	301.	0.

****
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
****

COMPLIANCE TEST REPORT

FLUORESCENT BULB CRUSHER
CLEAN HARBORS ENVIRONMENTAL SERVICES, INC.
CINCINNATI, OHIO

August 2003

by

Shaw Environmental, Inc.
11499 Chester Road
Cincinnati, Ohio 45246

PN 846142-01

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1.0 Introduction

On August 26, 2003, Shaw Environmental, Inc., personnel conducted emission tests on the fluorescent bulb crusher at Clean Harbors Environmental Services in Cincinnati, Ohio. Three test runs were conducted on the exit stack to determine particulate and mercury concentrations and mass emission rates. In addition, flue gas flow rate; temperature; and moisture, carbon dioxide (CO_2), and oxygen (O_2) contents were measured. Sampling and analytical procedures were those described in U.S. Environmental Protection Agency (EPA) Methods 1 through 5 and 29.*

The test team consisted of Messrs. Jerry Neese and Doug Cahill. Mr. Mike Crisenbery of Clean Harbors coordinated plant operations during the test. Ms. Sue Marshall of the Hamilton County Department of Environmental Services observed the test series.

2.0 Summary of Results

Particulate emissions data are presented in Table 1. Particulate concentrations are reported in grains per dry standard cubic foot (gr/dscf) and emission rates in pounds per hour (lb/h). The product of the particulate concentration and the flue gas flow rate yields the mass emission rate in pounds per hour.

Table 1
Filterable Particulate Emissions Data
Clean Harbors – Fluorescent Bulb Crusher (August 26, 2003)
(Shaw PN 846142-01)

Run No.	Time (24-h)	Concentration (gr/dscf)[a]	Emission Rate (lb/h)[b]
CH-1	0900-1003	0.00055	0.0035
CH-2	1043-1145	0.00028	0.0018
CH-3	1250-1351	0.00011	0.0007
Average		0.00031	0.0020

[a] gr/dscf = Grains per dry standard cubic foot at 68°F, 29.92 in.Hg., and zero percent moisture.

[b] lb/h = Pounds per hour.

* 40 CFR 60, Appendix A.

The filterable particulate data reported in Table 1 represent the material collected on the filter and in the probe. The average filterable particulate emission rate was 0.002 lb/h. The allowable emission rate is 0.11 lb/h.

Mercury emissions data are presented in Table 2. Mercury concentrations are reported in micrograms per dry standard cubic meter (µg/dscm) and emission rates in pounds lb/h. The average mercury emission rate was 7.5×10^{-6} lb/h. The allowable emission rate is 1.1×10^{-5} **lb/h.** Flue gas conditions are summarized in Table 3.

Table 2
Mercury Emissions Data
Clean Harbors – Fluorescent Bulb Crusher (August 26, 2003)
(Shaw PN 846142-01)

Run No.	Time (24-h)	Concentration (µg/dscm)[a]	Emission Rate (lb/h)[b]
CH-1	0900-1003	1.2	3.5×10^{-6}
CH-2	1043-1145	4.7	1.3×10^{-5}
CH-3	1250-1351	2.2	6.1×10^{-6}
Average		2.7	7.5×10^{-6}

a µg/dscm = Micrograms per dry standard cubic meter.

b lb/h = Pounds per hour.

Table 3
Summary of Flue Gas Conditions
Clean Harbors – Fluorescent Bulb Crusher (August 26, 2003))
(Shaw PN 846142-01)

	Flue Gas Flow Rate		Tempera-	Moisture		
Run No.	acfm[a]	dscfm[b]	ture (°F)	(%)	CO_2 (%)[c]	O_2 (%)[c]
CH-1	820	750	97	2.2	0	21
CH-2	800	730	97	2.3	0	21
CH-3	800	730	100	2.5	0	21
Average	810	740	98	2.3	0	21

a acfm = Actual cubic feet per minute at stack conditions.

b dscfm = Dry standard cubic feet per minute; standard conditions are 68°F and 29.92 in.Hg.

c Determined from Fyrite analysis.

3.0 Quality Assurance

All of the equipment used in the field testing was calibrated in accordance with the guidelines of Quality Assurance Handbook for Air pollution Measurement Systems, Volume III, EPA 600/R-94/038c. The calibration records are contained in Appendix E. All of the equipment used met the specifications of the EPA reference methods for accurate measurement.

Sampling was conducted in strict accordance with EPA reference method procedures. All field leak checks and sampling train temperatures met the specifications of the reference methods. Field data sheets are included in Appendix B of this report.

Table 4 summarizes the results of the particulate reagent blank analyses.

Table 5
Example Filter and Reagent Blank Analyses
Clean Harbors – Fluorescent Bulb Crusher (Shaw PN 846142-01)

Sample Type and Filter No.	Blank Value
Particulate - Reeve Angel 934 AH	0.1 mg
Acetone blank[a]	0.002 mg/g

[a] Maximum allowable blank correction is 0.01 mg/g; the indicated blank value was used.

The mercury level in the reagent blank was less than the practical quantitation limit of the method (0.2 μg).

4.0 Process Operation

This facility recycles fluorescent bulbs. The bulbs are shredded and gravimetrically separated into glass, metal, and calcium phosphate powder for further recycling off site. Emissions are controlled by activated carbon and a particulate filter.

The quantity of bulbs processed was 2,450, 2,400, and 2,775 for Runs CH-1, CH-2, and CH-3, respectively, for an average of 2,542 bulbs per test.

5.0 Sampling Location and Test Procedures

Two sampling ports were located approximately 54 stack diameters downstream and 8.7 stack diameters upstream from the nearest flow disturbances in the 8-inch inside-diameter stack. Eight traverse points (four per port) were used for particulate/mercury sampling. Each point was sampled for 7.5 minutes, for a total sampling time of 60 minutes per test run.

All sampling was conducted isokinetically by regulating the sampling rate relative to the flue gas velocity, as measured by the pitot tube attached to the sampling probe. The test methods are described briefly below. Appendix D contains Shaw Standard Operating Procedures for EPA methods 5 and 29.

5.1 Velocity and Gas Temperature

All gas velocities were measured with a Type-S pitot tube and a 0- to 10-inch inclined manometer. In all cases, velocities were measured at each sampling point across the stack to determine an average value according to procedures described in EPA Method 2. Temperatures were measured at each point with a thermocouple and digital temperature indicator. Due to the small stack diameter, velocity and temperature measurements were made before and after each test run in accordance with EPA Method 1A procedures.

5.2 Molecular Weight

CO_2 and O_2 concentrations were determined by Fyrite analysis during each particulate/mercury test.

5.3 Moisture

The flue gas moisture content was determined using EPA Method 4 procedures. Testing was conducted in conjunction with particulate/mercury testing.

5.4 Particulate/Mercury

Particulate and mercury emissions were measured using EPA Method 5 and 29 procedures. The sampling train used for each test consisted of a glass nozzle, a heated borosilicate glass-lined probe, a heated 3-in.-diameter quartz-fiber filter, and a series of Greenburg-Smith and modified impingers containing 4% potassium permanganate/10% sulfuric acid ($KMnO_4/H_2SO_4$). The nozzle, probe, and filter holder portions of the sampling train were acetone-rinsed at the end of each test. The acetone rinse and the particulate caught on the filter media were dried at room temperature, desiccated to a constant weight, and weighed on an analytical balance. Total filterable particulate matter was determined by adding these two values.

The contents of the impingers were measured gravimetrically to determine the moisture concentration. The contents of the first three impingers were recovered and the nozzle, probe, filter holder, impingers, and connecting glassware were rinsed with $KMnO_4/H_2SO_4$ solution and then with distilled water. The filters and probe rinse residue (following particulate analysis) and impinger solutions were digested and analyzed for mercury by cold vapor atomic absorption spectroscopy.

CLEAN HARBORS ENVIRONMENTAL SERVICES
STANDARD OPERATING PROCEDURE
Lamp Recycling System

Cleanharbors Chicago Facility Date: February 16, 2004
Revision 0

1. Purpose:

1.1 The purpose of this document is to provide detailed guidelines and procedures necessary to process Mercury lamps in an appropriate, effective, and safe manner.

2. Scope:

2.1 Lamps enter this system on a power-feed belt conveyor passing through a negative pressure air chamber. Each lamp is crushed, separating glass and metal components into individual co products storage bins. Phosphor powder collects in the multi-storage filtration system. All materials will be stored for subsequent recycling.

3. Pre-Start Up Inspections:

3.1 Inspect the unit and associated parts for defects.
3.2 Ensure fan is operational.
3.3 Ensure all product receptacles are empty and in position to receive the materials as they are discharged.
3.4 Ensure that the four drums around the unit are properly positioned and have straight, unobstructed connection boots and secure connection rings.

4. Start up Operations

4.1 Ensure that the knife switch on the control panel is in the "ON" position.
4.2 Turn the key switch on the touch pad to the "ON" position.
4.3 Unless otherwise stated from your manager, the unit should be run in the **"automatic"** mode. Press the "automatic" selection on the touch screen.
4.4 Press "system start". A five second buzzer will sounds indicating that the machine is ready to start.
4.5 When the buzzer shuts off, the system will start in a sequence.
4.6 When all of the systems are operating all indicator lights of the system will be lit, except "Vacuum Bar and HID".
4.7 The system is now ready to accept lamps.

5. Process

Feeding Conveyor #1

5.1 Lamps are to be placed on the #1 feed conveyor manually end-to-end and stacked no higher than the guard on the end of the conveyor.
5.2 **DO NOT** feed cardboard, wood, plastic, or other debris into the machine.
5.3 Record on the process sheet the volume of boxes of lamps crushed per hour.
5.4 Sign, date, and turn in to department manager. Department manager to process out and file in office.
5.5 **DO NOT** exceed 4000 lamps per hour.
5.6 When any of the co-product material containers are full, an alarm will sound and the system will shut down and will identify the container on the PLC. Replace the full container and restart the system.
5.7 Full containers of Phosphor powder will be handled as a hazardous waste and placed in to the appropriate storage area.
5.8 Full containers of metal end caps and glass will be a non- hazardous waste.
5.9 All containers will need assigned a tracking ID number prior to placing in to storage.

Feeding the Crusher Box

5.1.1 Remove the HID lamps from the container and place them in the crusher box.
5.1.2 Close the box and ensure the latch is shut.
5.1.3. Press the black start button on the side of the crusher box.
5.1.4 Allow 10 seconds for the outer glass to be crushed. The crusher box door will not open until the cycle is fully complete.
5.1.5 Remove the frames and the mercury bearing arc tubes from the unit and place in separate containers.

6. Hazards:

6.1 Chemical exposure to particulate or fumes (phosphor powder, glass fines, mercury vapor)
6.2 Forklift hazard (transporting lamps and material containers to and from the unit)
6.3 Slip, trip, fall hazard
6.4 Cut / laceration / puncture hazard (broken lamps, sharp edges on aluminum pieces)
6.5 Ergonomic stresses (loading of lamps onto conveyor #1)
6.6 Moving parts (conveyors, crushing drums)

7. Shut down Procedure:

7.1 Allow the system to continue running for a minimum of ten minutes after the last lamp has been fed through. This will prevent the release of any residual mercury vapors and/or phosphor powder.
7.2 During this time the operator should use the attached vacuum (positive displacement) and sweep the area thoroughly of any and/or all-residual phosphor powder or glass in the area. DO NOT dry sweep these materials as they likely contain mercury.
7.3 Press the system shut down key on the touch screen panel.
7.4 Allow the vapor fan to continue running to keep the unit under negative pressure.
7.5 Empty co-product material containers if needed.
7.6 **Weekly** – The surrounding work area (hot zone) is to be mopped with a solution of HgX, and the shell of the unit should be wiped completely down with an HgX solution.
7.7 All rags and clothes used for cleaning will be placed in a proper container and staged for subsequent disposal in appropriate area.

8. Emergency shutdown:

8.1 If at any time the machine needs to be immediately shut down and operator should depress one of the four Emergency shutdown buttons located on the machine. Three emergency buttons are located at the front of the machine, and one at the back of the machine.
8.2 To prevent fugitive vapor emissions the vapor collection system must be restarted immediately following the treatment of emergency.

9. Maintenance:

9.1 Maintenance activities conducted during operation of the unit shall be conducted in the personal protective equipment outlined in the section below.
9.2 All other maintenance activities involving opening up a portion of the unit including filter changes, conveyor maintenance, etc. shall be conducted in the PPE listed below unless the unit has been fully decontaminated.

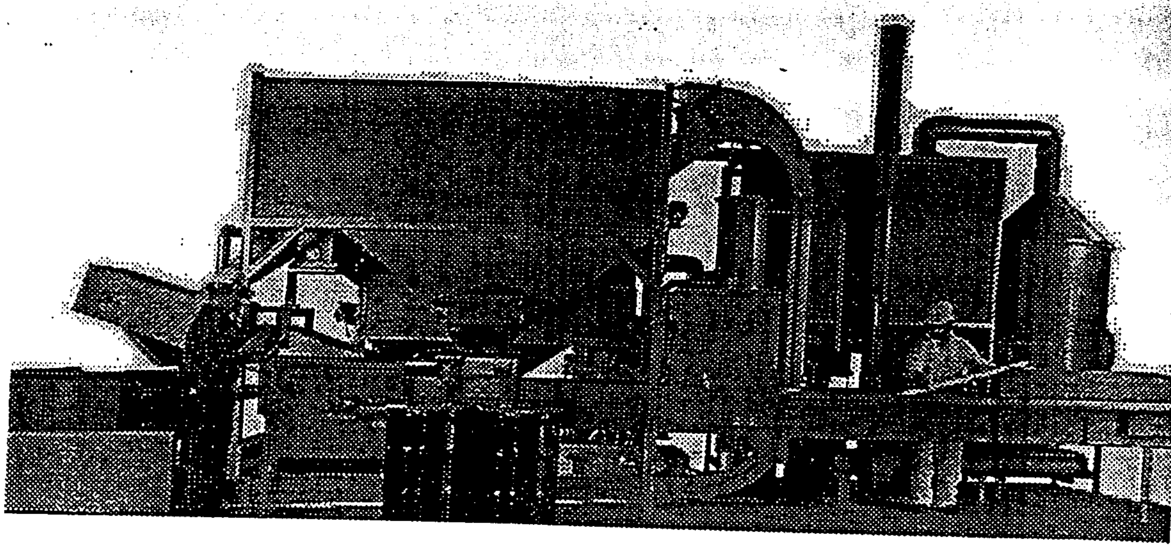
10. Personal Protection Equipment:

10.1 CPF I apron (Chemical Resistant)
10.2 Cut proof outer gloves (Kevlar) with Nitrile inner gloves
10.3 Hard Hat
10.4 Half Face APR with Face shield or full-face respirator
10.5 Mersorb – P100 cartridges
10.6 Kevlar sleeves
10.7 Hearing protection
10.8 Steel Toe Boots

11. **Chemical Hygiene:**

11.1 Consumption of food, beverage or tobacco is prohibited in areas where lamps are handled, stored or processed.
11.2 All operators will be required to wash their hands and face thoroughly with soap and water before breaks and meals.
11.3 Showers will be required at the end of the work shift.

RESOURCE TECHNOLOGY, INCORPORATED



Model LSS1
Lamp Recycling System

Revised May 31, 2000

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1.0 Introduction

2.0 Process Description

2.1 General Description

The Model LSS1 Lamp Recycling System achieves the goal of setting a new standard for simplicity, safety, and recycling efficiency. Lamps enter this system on a power-feed belt passing through a negative pressure air chamber. Each lamp is crushed, separating glass and metal components into individual coproducts storage bins. Phosphor powder collects in the multi-stage filtration system. This powder should be treated in other equipment to recover elemental mercury for commercial use. Mercury vapors adsorb onto activated carbon filters eliminating fugitive emissions during processing. The Model LSS1 is fully computerized assuring easy operation. A touch screen control module provides one touch start-up for the entire system. This feature also provides operational monitoring of process and coproducts recovery lines. The Model LSS1 may include optional equipment that will continuously monitor the exhaust vent and provide a permanent record of system air quality.

2.2 Capacity and Performance

The Model LSS1 Lamp Recycling System has the capability of processing 2300 pounds (952 kg) of fluorescent lamps per hour. This equates to approximately:

T-12	T-8 lamps
3,500 4-foot	5,250 4-foot
1,750 8-foot;,	3,075 8-foot

The Model LSS1 also handles circular and U-shaped fluorescent lamps, high intensity discharge lamps, and more.

2.3 Equipment Description

1. **#1 Lamp Feed Conveyor**: The #1 Lamp Feed Conveyor receives the manually loaded fluorescent lamps and transports them to the implosion chamber conveyor. The implosion chamber conveyor consists of a conveyor belt, loading aprons, electric motor, and gear reducer.
2. **#2 Lamp Feed Conveyor**: The #2 Feed Conveyor receives the fluorescent lamps from the #1 Feed Conveyor and transports the bulbs to the breaker bar. The #2 Feed Conveyor and all subsequent components to this system are enclosed and operated under vacuum to collect fugitive mercury emissions.
3. **Breaker Bar**: The Breaker Bar is comprised of rotating steel arms which break the lamps prior to their being gravity-fed into the primary crushing drums.

4. **Primary Crushing Drums**: The Primary Crushing Drums consist of two rotating steel drums which crush the lamp components and deposit the particles on the elevating conveyor.
5. **Elevating Conveyor**: The Elevating Conveyor receives the crushed lamps from the primary crushing drums and transports them to the primary trommel.
6. **Primary Trommel**: The Primary Trommel utilizes a multi-layer screen which separates the components by particle size. Larger (aluminum end-caps) are retained within the screen and are discharged for recycling. Particles between one inch and 1/16 of one inch (glass) are retained by the screen and continue onto the secondary trommel via the vibrating conveyor. Particles less than 1/16 of one inch pass through both screens to a 100 mesh vibrating screen separator. The rotating action of the primary trommel provides enough agitation to scrub the phosphor powder and mercury from the aluminum end-caps and from the glass particles.

   ***Note*: After passing through the Primary Trommel, the aluminum is discharged via a chute to a receiving container which can then be shipped as a commodity for recycling.**

7. **Vibrating Screen Separator**: The Vibrating Screen Separator receives phosphor powder and glass fines from the primary trommel. The Vibrating Screen Conveyor retains clean glass fines and transports them to a drum for recycling. The calcium phosphate powder passes through the vibrating screen and is collected in sealed drums for transport to a mercury retorting facility.
8. **Secondary Trommel**: The Secondary Trommel receives material from the primary trommel via a vibrating conveyor and again agitates and scrub the glass. The glass particles that do not pass through the 1/16 of one inch openings in the outer screen of the secondary trommel are gravity-fed into the secondary crushing drums.
9. **Secondary Crushing Drums**: The Secondary Crushing Drums consists of two rotating steel drums which crush the lamp glass to its final size and deposits the glass on the magnetic conveyor.
10. **Magnetic Conveyor**: The Magnetic Conveyor receives particles of glass from the secondary crushing drums and transports them to a receiving container. Metallic particles (filaments and aluminum end-caps attached to filaments) attract to the magnetic conveyor and are transported to an additional receiving container which can then be shipped for recycling.
11. **HID De-Globing Chamber**:
    The HID de-globing chamber serves to remove the outer glass from the HID lamps. Most all configurations of lamps may be placed socket

lamps per cycle. After loading, the door must be closed and the cycle start button depressed. This will activate the de-globing process. Upon completion of this cycle the door to the chamber may be opened. The HID frames and mercury bearing arc tubes are manually removed from the chamber. Using a wire cutting device the operator should separate the two remaining components. The wire is ready for recycling at a local metals recycler and the mercury bearing arc tube should be sent off for retort.

12. **Vapor Collection System**: The Vapor Collection System is designed to control mercury vapor and dust emissions from the process. The vapor collection system is comprised of a five horsepower fan, a baghouse equipped with a series of particulate filters, an air compressor for filter back purge, and an activated carbon vessel. The blower which produces an air flow of approximately 500 CFM draws mercury vapors and dust from the process equipment into the baghouse. The baghouse incorporates a set of nine cylindrical particulate filters that are in series with a set of two flat rectangular filters. This filter arrangement is designed to trap 99.99% of air-borne particles measuring 0.5 microns or larger. Purge occurs once each hour of running time on the feed belts. The purge opens a diaphram and back purges the filters with a powerful burst of compressed air. When the system computer senses that back purging the filters is no longer effective at reducing the pressure drop across the filters, the process control system will disable the system and display the appropriate alarm signal on the touch screen. The system can be restarted following the replacement of the filters. Dust accumulates in the collection barrel located underneath the baghouse.
13. **Housekeeping Vacuum System**: The LSS1 is supplied with a positive displacement vacuum pump connected to the vapor collection system. Controlled manually at the touch screen it is used for general housecleaning around the system
14. **Process Control System**: The Process Control System incorporates a programmable logic controller, touch screen, main disconnect, fuses, motor starters, and thermal overload protection for the equipment. The system operation is accomplished by following user prompts on the touch screen. Example screens are included in Appendix A and an electrical diagram is included in Appendix D. The system control logic is such that when in automatic mode no component can be operated without the vapor collection system or without the activation of the previous component in the process. The main control panel contains high voltage components and should only be accessed with the main disconnect in the off position and after following proper lock-out/tag-out procedures, located in section 3.5 of this manual.

2.4 System Specifications

Height: 12 feet (3.66 meters)
Length: 30 feet (9.15 meters)
Width: 11 feet (3.35 meters)
Electrical Requirements: 100 AMP, 208/230/460 volt, 3 phase
Electrical control panel is UL approved.

3.0 Safety

3.1 General Safety Awareness

The LSS1 should be used in accordance with the manufacturer's instructions and good safety and health practices. The manufacturer also recommends that a health and safety professional be consulted regarding mandatory personal protective equipment (P.P.E.) and safety practices prior to the operation of the system.

3.1-1 Warning Signs

The LSS1 contains signs and labels required by OSHA 29 CFR 1910.145 and convey pertinent hazard warning information to the operator that is needed during the operation of this equipment.

3.1-2 Emergency Stop Buttons

Emergency stop buttons are located in four areas on the LSS1; three are on the front or operating side of the equipment, and one on the back side. Anytime there is an emergency and the LSS1 must be stopped immediately, an operator can depress any one of the four emergency stop buttons. This will completely shut down the LSS1, including the vapor fan. In order for the LSS1 to restart, the emergency stop button that was activated must be pulled out to deactivate the emergency stop condition, and the system must be restarted at the touch screen.

3.1-3 Safety Interlocks

When operating in the automatic mode, the LSS1 is programmed through the Programmable Logic Controller (PLC) which prevents operation of the system without operating the vapor collection system. Furthermore, no system component can be operated out of sequence. Additional information concerning control logic is included in section 5.2 of this manual.

3.1-4 Machine Guarding

The Model LSS1 is designed and manufactured to provide a safe work environment for the operator. The LSS1 meets the requirements of OSHA 29 CFR1910.212 Machine Guarding Standard.

3.2 Operator Training Requirements

Operators of the LSS1 should be trained in compliance with the requirements of the Occupational Safety and Health Administration (OSHA) 29 CFR1910.120(p) for hazardous waste site workers. Additional training or certifications may be required by state or local agencies and should be researched and obtained prior to operation of this system. Training should include proper emergency response procedures and reporting requirements. Additionally, operators should be informed of the potential for adverse health effects resulting from the improper handling of mercury-containing material. Operators should be familiar with respiratory protection devices and other personal protective equipment which should be worn during the operation and maintenance of this equipment. Finally, operators should be familiar with the lock-out procedures which are outlined in section 3.5 of this manual.

3.3 Chemical Hygiene

While operating the LSS1, operators should follow good chemical hygiene practices. This is done by prohibiting consumption of food or beverage and use of tobacco products in areas where lamps are handled, stored or processed. Operators must use the proper P.P.E. while handling or processing lamps. Operators should wash their hands and face thoroughly with soap and water before breaks and meals, and shower at the end of the work shift.

3.4 Personal Protective Equipment

The LSS1 separates fluorescent lamps into three primary components: clean aluminum end-caps, clean crushed glass, and calcium phosphate powder (phosphor powder) containing mercury. Each of these waste streams has a potential to cause injury or illness if handled improperly. The aluminum end-caps and crushed glass have sharp edges and can produce cuts and puncture wounds in unprotected operators. As a minimum requirement, protective gloves should be worn any time lamps are being handled or loaded. Phosphor powder containing mercury vapor is released from the lamps and collected throughout the system. Mercury can be introduced into the body by inhalation, absorption and ingestion. Care should be exercised in avoiding inhalation of this powder. Use of respiratory protection during certain operations and maintenance of this equipment is required. Specific personal protective equipment which is to be worn will be outlined in the following sub-sections.

3.4-1 Respiratory Protection

Since the primary root of mercury vapor entry into the body is through inhalation, respiratory protection may be required during certain operations and maintenance performed on the LSS1. Respiratory protection should be used anytime mercury vapors are present. Respiratory protection should be worn if a direct reading mercury vapor instrument indicates that mercury vapors are present during operation.

3.4-2 Eye Protection

Safety glasses shall be worn at all times while handling lamps, operating the LSS1, or conducting maintenance on the LSS1.

3.4-3 Hearing Protection

OSHA 29 CFR1910.95 the Occupational Noise Exposure Standard states that any employee exposed to 90 decibels of sound or greater for an eight hour period of time is required to wear hearing protection. The Model LSS1 Lamp Recycling System generates approximately 90 dBA of noise while in full operation. Therefore, all such exposed operators and anyone around the LSS1 while it is operating are required to wear hearing protection.

3.4-4 Body Protection

Since the phosphor powder contained in fluorescent lamps contains mercury, it is important that protective coveralls be worn by all personnel who are operating or conducting maintenance on the LSS1. This is important so that cross contamination does not occur from the phosphor powder collecting on their work uniforms.

3.5 Lock-out Procedure

In order to ensure that employees performing maintenance or repairs on the LSS1 do not become injured by accidental start-up or release of stored energy, all required precautions as outlined in OSHA 29 CFR 1910.147 Lock-Out/Tag-Out Standard should be followed.

The Procedure:

Step 1: Locate the circuit breaker that supplies power to the main control panel. Turn off the circuit breaker and lock-out the circuit breaker.

Step 2: Go to the main control panel for the LSS1 and turn off the knife switch on the outside of the electrical panel and lock that switch in the off position. Following the directions on the front of the panel, open the control panel. Check to ensure that the main breaker has been turned off. Then go to the touch screen and attempt to operate the equipment .

Step 3: Go to the rear of the LSS1 to the electrical switch for the air compressor, turn the switch to the off position , close the lock-out hasp over the switch, and place the lock through the hasp on the switch.

Step 4: Open the air system drain valve on the air compressor, this is to make sure there is no stored pneumatic energy in the LSS1.

Step 5: Turn the air system ball valve to the off position. Close the lock-out hasp over the valve and place a lock through the hasp on the valve.

Step 6: Attempt to operate any part of the LSS1 in order to verify that there is no stored energy within the equipment. After completion of the previous steps, you may perform the required work on the LSS1. In order to return the LSS1 to service, make sure all tools and equipment are removed from the machine and all components are secured back in the machine and follow the lock-out steps in reverse order.

3.6 Air Monitoring

Air monitoring for mercury vapor concentration should be conducted in the area around the LSS1. A direct reading mercury vapor instrument should be used to collect this data. Air monitoring should be conducted in the operator work area, vapor fan stack, and coproduct's collection areas to ensure that all employees working around the LSS1 will not be exposed to mercury vapor concentrations above the ACGIH Threshold Limit Value (TLV). If at any time the mercury vapor readings get close to the TLV, the people working in the affected area should don air purifying respirators, and correct the cause of emission.

4.0 Pre-operation and Start-up

The LSS1 start-up is accomplished by using the touch screen and following the prompts as they appear and as outlined in section 4.2 below.

4.1 Pre-operation Inspection

Prior to start-up of the LSS1, a walk around inspection should be performed to ensure that all coproduct receptacles are empty and in position to receive the co-products as they are discharged from the LSS1. Furthermore, ensure that the four drums around the LSS1 are properly positioned and have straight, unobstructed connection boots and secure connection rings.

4.2 Equipment Start-up

The LSS1 is designed to run in an automatic mode. When the LSS1 runs in its automatic mode, all equipment operations are supervised through the programmable logic controller (PLC). If there is an alarm, the LSS1 will stop and indicate the reason for the alarm. To start the LSS1, make sure the circuit breaker supplying the LSS1 control panel is in the "ON" position. Proceed to the LSS1 main electrical panel and make sure that the knife switch on the control panel is in the "ON" position. Proceed to the front of the LSS1, turn the key switch on the touch pad to the "ON" position, follow the prompts on the screen, and touch the screen in the areas indicated to make your selection. To run the LSS1 in the Automatic mode press "automatic" in the selection area of the screen. When the automatic screen appears, press the system start to activate a five-second buzzer which indicates that the system will start. When the buzzer shuts off, the system will start in a sequence. When all of the systems are operating all indicator lights of the system, except "Vacuum Bar and H.I.D.", will be lit. It is at this point that you can start feeding lamps into the LSS1.

5.0 Equipment Operation

5.1 Feeding Lamps into Equipment

Lamps are manually placed on the #1 Feed Conveyor by trained operators. The Model LSS1 is designed to process approximately 3,500 lamps per hour. The lamps can be continuously laid end-to-end completely across the conveyor. Be careful not to place the lamps any higher than the guard at the end of the conveyor. This will avoid having the lamp break prior to entry into the implosion chamber conveyor. **DO NOT** feed cardboard, wood, plastic, or other debris into the machine as such will clog the vacuum lines or jam the equipment.

Caution: In order to prevent jamming of the machine, plastic coated lamps must not be placed directly on feed conveyor #1.

5.2 Monitoring Equipment Operation

The process control system incorporates a programmable logic controller (PLC) which monitors equipment operation. Should a motor overload, filters become clogged, or an emergency stop button be depressed, the PLC will shut down that system and alert the operator to the problem. During normal operations it is important to pay attention externally to equipment operation. Look for signs of wear and tear such as leaking or clogged vacuum lines. Listen for any sound abnormalities that may indicate a bearing failure, a motor failure, or a jam in the equipment. It is also important to monitor the levels of glass, aluminum, fines, and powder discharged to containers. Proximity sensors are mounted in the lids of the drums attached to the glass fine discharge, the powder discharge, baghouse discharge and the vacuum container discharge. These switches will shut off equipment operation via the PLC should the containers become full. When full, please check the touch screen alarm screen for indication as to which drum needs to be changed out. When a new drum is placed back into position, the PLC will allow operation to continue.

5.3 Monitoring Coproduct Quality and Volume

Quality in the lamp recycling business refers to how well the process can separate the hazardous materials from the non-hazardous materials. In order for the process to perform properly, the crush and separation operation must separate the end-caps, glass and contaminated powder from the other components. During normal operation, it is important to inspect the coproducts and coproduct discharge areas to ensure that there is no mixing of coproducts or cross contamination of materials (e.g. visible phosphor powder on the glass or aluminum end-caps, or glass-laden aluminum end caps).

One simple method to inspect glass quality is to put on rubber gloves and pick up a handful of glass gently and return it to the storage container. Inspect the rubber glove for evidence of powder. It may be necessary to sample the clean glass and the clean aluminum in order to maintain compliance with permit regulations.

It is important during operation of the LSS1 to monitor both the glass and aluminum discharge to assure that material is flowing freely and that no back-up of material will occur through the discharge chutes. Glass may be discharged into containers as small as 55 gallon drums or as large as semi trailers with optional equipment. Aluminum may also be discharged in the same manner. It is important to monitor these discharges as often as necessary to ensure that those containers do not get overfilled.

5.4 Using the Housekeeping Vacuum

The LSS1 is supplied with a positive displacement vacuum pump connected to the vapor collection system. The household vacuum system is controlled at the touch screen and is programmed to operate only when the LSS1 is running in the automatic mode. It is used for general housecleaning around the LSS1. Vacuum ports are located at various points around the equipment and are to be used to collect small particles of glass, aluminum, and phosphor powder. These materials will then be separated throughout the remainder of the system . It is important to ensure that a vacuum hose is attached to an open vacuum port prior to initiating the vacuum system. Otherwise, damage may result to the vacuum system. It is important to vacuum only lamp components into the system so that foreign materials do not contaminate recyclable materials or cause blockages when passing through the machine.

6.0 Equipment Shutdown

6.1 Emergency Shutdown

If at anytime the LSS1 needs to be immediately shut down, an operator should depress one of the four emergency stop buttons located on the LSS1. Three emergency stop buttons are located on the front of the machine, and one is located on the back. In order to deactivate the alarm and restart the LSS1, the emergency stop button that was activated must be pulled out from the stop position. Note that the vapor collection system is disabled with an emergency shutdown. To prevent fugitive vapor emissions the vapor collection system must be restarted immediately following the treatment of the emergency.

6.2 Routine Shutdown

At the end of the production day or when you want to shut down the LSS1, simply press the system stop button on the touch screen of the automatic menu. This will shut down all operations of the LSS1 with the exception of the vapor fan.

(The vapor fan should be allowed to continue to operate even though the LSS1 is not actively processing lamps. This will ensure that a negative pressure is maintained within the LSS1, preventing the release of mercury vapors from any residual lamps or phosphor powder that may remain in the system.)

6.3 Daily Clean-up Procedures

At the end of each shift, the LSS1 should be allowed to continue to operate in the automatic mode for at least 10 minutes following the cessation of all processing. During this period the LSS1 equipment and surrounding floors should be swept of all visible calcium phosphate powder (phosphor powder) in order to decontaminate the area of mercury vapor. Coproduct collection containers should also be emptied at this time.

7.0 Routine (Scheduled) Maintenance

Below is a list of scheduled maintenance items:

ITEM	MONTHLY	SIX MONTH	ANNUAL
#1 Feed Conveyor	X	X	X
#2 Feed Conveyor	X	X	X
Elevated Conveyor Flights	X	X	X
Gear Reducers Oil Change		X	X
Carbon			See below
Glass Conveyor	X	X	X
Trommel Rollers	X	X	X
Air Compressor Oil	X	X	X
Vacuum Pump			X
Vacuum Blower Motor			X
All Air Lines	X	X	X

DAILY: Perform visual equipment inspection, check visible components for visible wear. Check nuts, bolts for tightness.

#1 Feed Conveyor: Inspect for tracking, wear and tension.
Adjust tracking and tension if necessary, replace if worn.

#2 Feed Conveyor: Inspect for tracking, wear and tension.
Adjust tracking and tension if necessary, replace if worn.

Elevated Conveyor Flights: Inspect the flights for wear, replace if wear is excessive.
Replace if UHMW wear strips are worn down to the metal flite

Gear Reducers: Check seals.
Change oil.

Carbon: Change when exhaust levels exceed regulatory levels.

Air Compressor: Change oil.

Vacuum pump: Change oil.

Air Lines: Check connections for air leaks

Every 100,000 lamps: Inspect clean-out points. Clean as necessary at the following locations: Feed conveyor side doors, Trommell #1 end access, vibrating conveyor port, magnetic conveyor tail.

8.0 Recommended Parts Inventory

SPARE PARTS INVENTORY

PARTS	QUANTITY
Conveyor Belt 1	1
Conveyor Belt 2	1
Cylindrical HEPA Filters	15
Square HEPA Filters	2
Air Compressor Oil	
Elevated Conveyor Flights	1 set
Elevated Conveyor Divider	1

Vacuum Blower Motor Oil - Mobil DTE BB
Texaco R & O 220
Amoco 220, or equal

Vacuum Blower Bearing Grease - Follow Manufacturers Recommended Instructions

Gear Reducer Motor Oil - Mobil 600 W Super
Texaco Honor cyl. Oil 680
Chevron NL Gear Comp 680

Touch-up Paint

Air Line

Gasketing Material (foam)

Gasketing Material (perma gum)

Silicone Sealant (RTV)

9.0 Warranty and Disclaimer

Resource Technology, Inc. ("RTI") warrants that its Model LSS1 Machine will be free from defects in materials and workmanship at the time of RTI's and for a period of 90 days thereafter exclusive of conveyor belts, which are excluded from warranty coverage; and electrical components, which are subject only to applicable manufacturer's warranties, if any.

During this limited warranty period RTI will provide new replacement parts or Equipment on an exchange basis as set forth below. All replaced parts or Equipment become the property of RTI. This limited warranty also does not include service to repair damage resulting from any accident, disaster, misuse, abuse, or any non-RTI installation, modification or attempted repair of the Equipment.

FOR WARRANTY SERVICE OR ASSISTANCE IT IS REQUIRED THAT A SERVICE REQUEST BE MADE WITHIN THE WARRANTY PERIOD. NO EQUIPMENT OR PARTS MAY BE RETURNED TO RTI WITHOUT RTI'S PRIOR WRITTEN AUTHORIZATION, AND ALL SUCH RETURNS WILL BE AT CUSTOMERS SOLE EXPENSE. If shipping is authorized, Customer must also prepay applicable RTI part or Equipment shipping charges and either obtain shipping insurance or assume the risk of loss or damage in transit. RTI reserves the right to charge Customers' account for replacement of parts or Equipment which are subsequently determined to be outside of Limited Warranty coverage, including applicable travel or service call charges.

THIS LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY OFFERED BY RTI, AND NEITHER RTI NOR ANY REPRESENTATIVE MAKES ANY OTHER REPRESENTATION OR WARRANTY OF ANY KING, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTIES OR MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow limitations or exclusions of implied warranties, so the above exclusions may not apply to you.

CUSTOMER'S SOLE REMEDY UNDER THIS LIMITED WARRANTY SHALL BE PART OR EQUIPMENT AS PAROVIDED ABOVE. IN NO EVENT WILL RTI BE LIABLE FOR ANY DAMAGES, INCLUDING ANY ALLEGED DOWNTIME, LOST PROFITS, LOST SAVINGS, OR OTHER SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE SUCH EQUIPMENT, EVEN IF RTI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

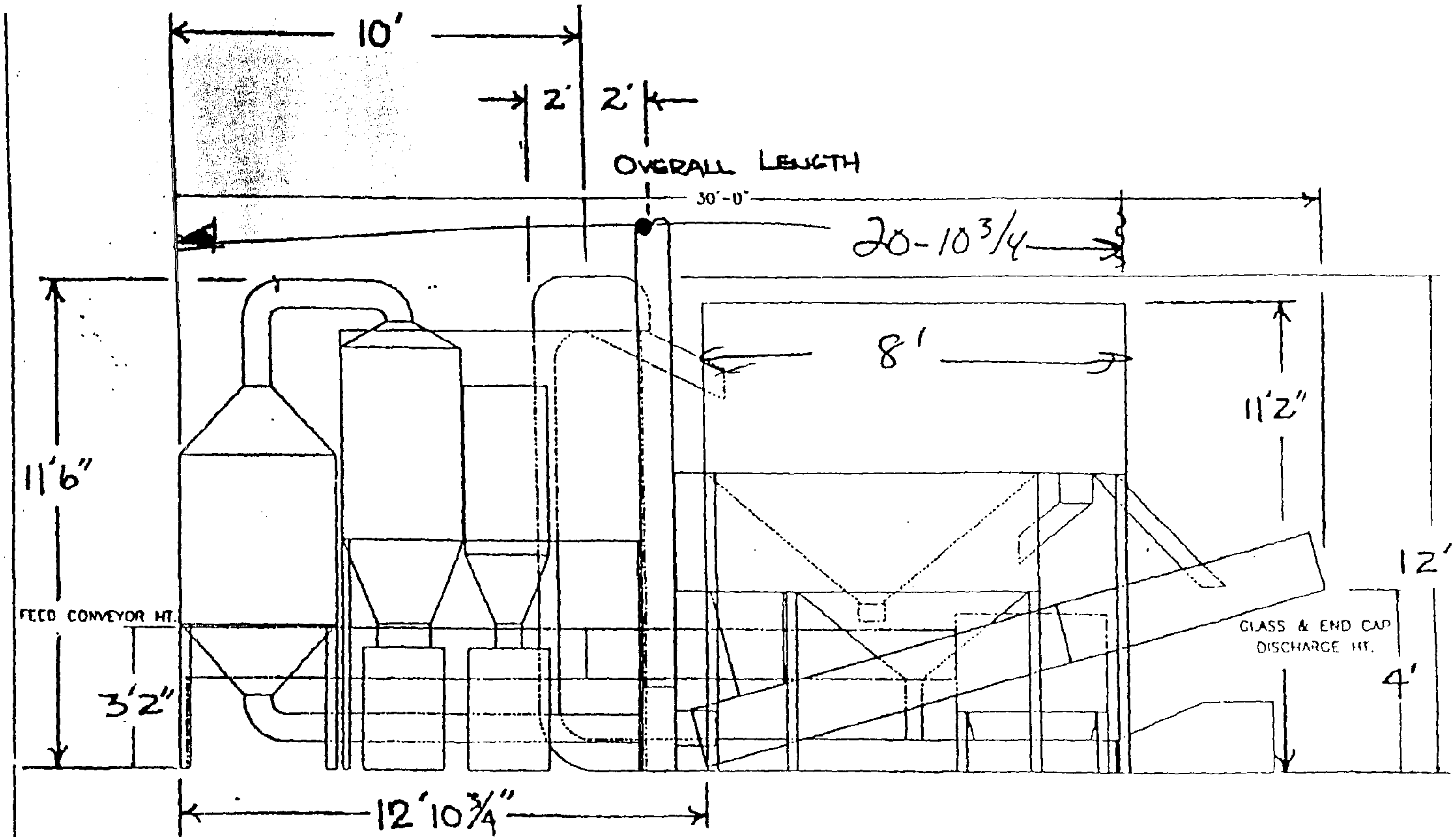
APPENDIX B:
Trouble Shooting Guide

Symptom	Possible Causes	Corrective Action
Feed conveyors stop	• Debris between conveyors • Belt is ripped • Debris in systems • Belt tension too loose • Conveyor pulley moved from center • Key is dislodged from shaft or reducer	• Remove debris • Replace belt • Remove debris • Adjust belt tension • Re-position pulley • Replace key in shaft
Crushing drums stop turning	• Debris in system (nuts, bolts, wood, etc.) • Key is dislodged from shaft	• Reverse motor to clear jam • Remove cover to clear debris • Replace key in shaft
Elevated conveyor stops	• Material overload • Debris in system • Key is dislodged from shaft	• Reverse conveyor to clear jams • Open cleanout(s) to remove material/debris
No power	• Main breaker off • Knife switch off • Key switch off	• Turn on main breaker • Turn on knife switch • Turn on key switch
Phosphor powder coming from co-product chute	• Clogged vapor lines	• Check ports • Clear lines
Baghouse filters clogged	• Air pulse system not working • Filters at end of service life	• Turn on air compressor • Ensure valve is open • Change filters
No air pressure	• Air compressor not turned on • Air compressor unplugged • Ball valve not closed • Mechanical problem • Filter has been ruptured and carbon contaminated with phosphor powder • Leak in air line	• Turn on air compressor • Plug in air compressor • Open valve • Replace air line • Replace cylindrical and square particulate filters – replace carbon
High mercury vapor emissions from exhaust stack	• Carbon is saturated	• Replace carbon
Air compressor will not shut off	• Diaphragm valve stuck open • Air line disconnected or damaged	• Disassemble and clean • Reconnect or replace

*Should a component that is commercially available fail, please refer to the component manufacturer's manual

APPENDIX C:
Inspection Form

	YES	NO
Make sure coproduct containers are empty and are ready to receive material.		
Make sure drum connection boots are straight, and connecting rings are secure.		
Make sure the power is turned on to the control panel..		
Turn on the air compressor, open the air valves.		
Walk around and inspect the machine. Look for loose nuts, bolts, fittings. Listen for air leaks. Check air gauges for proper pressure: **Compressor 140 psi** **Top Regulator 95 psi** **Lower Regulator 65 psi**		
Stage material for processing.		
Turn the key switch on the tough screen to the "ON" position.		
Follow the instructions on the touch screen. Proceed to run the equipment in "Automatic" mode.		
Perform air monitoring in the operator area, co-product area, exhaust stack.		
Begin processing lamps.		

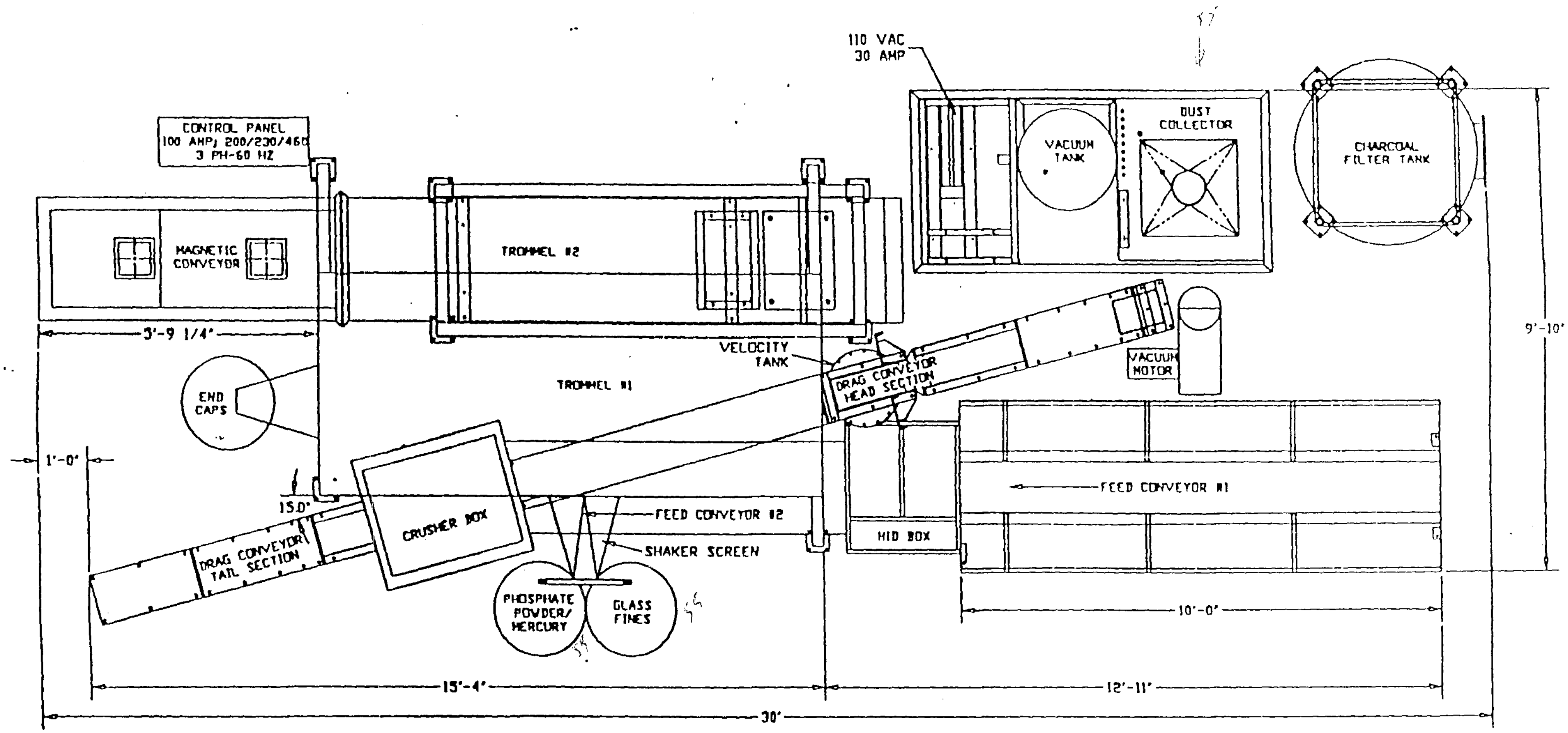


MODEL LSS1

SIDE ELEVATION

ATT: DAN GLENN

RESOURCE TECHNOLOGY INC.
520 WEST ST.
VAN METER, IA.


110 VAC
30 AMP
CONTROL PANEL
100 AMP; 200/230/460
3 PH-60 HZ
DUST COLLECTOR
VACUUM TANK
CHARCOAL FILTER TANK
MAGNETIC CONVEYOR
TROMMEL #2
9'-10"
3'-9 1/4"
VELOCITY TANK
END CAPS
TROMMEL #1
DRAG CONVEYOR HEAD SECTION
VACUUM MOTOR
1'-0"
15.0°
FEED CONVEYOR #1
CRUSHER BOX
FEED CONVEYOR #2
MID BOX
DRAG CONVEYOR TAIL SECTION
SHAKER SCREEN
PHOSPHATE POWDER/ MERCURY
GLASS FINES
10'-0"
15'-4"
12'-11"
30'

MODEL LSS1

CleanHarbors
ENVIRONMENTAL SERVICES, INC.

11800 South Stony Island Avenue
Chicago, IL 60617
773.646.6202
Fax 773.646.6381
www.cleanharbors.com

August 25, 2004

Mr. Mark A Schollenberger, P.E.
Illinois Environmental Protection Agency
Bureau of Land – Permit Section
1021 North Grand Avenue East
Springfield, IL 62702

Dear Mr. Schollenberger:

Clean Harbors Services, Inc. (CHSI) is submitting additional information concerning its application for a Class 3 permit modification for the addition of a lamp crushing machine for Building 25.

The lamp crushing machine is currently operating at Clean Harbors Cincinnati, OH facility. Metal recovered from the crushed bulbs is sent to Victor Metal in Wickliffe, OH for reclamation. Glass recovered from the crushed bulbs is sent to Dublak in PA. For reuse. There is also one additional drum associated with the unit for metal. All containers of recovered material will be kept on-site a maximum of 90 days from when material is placed into them.

For clarification, when the unit is shutdown from normal operation the vapor fan will continue to operate. CHSI will continue to run the fan for at least ten minutes following cessation of all processing. During emergency shutdown, even the vapor fan will stop. CHSI will restart the fan immediately following the treatment of the emergency. This is consistent with the operating manual Nos. 6.1 and 6.2 which was included as Attachment 2 in the original submittal. CHSI will also follow the routine maintenance procedures outlined in Section 7.0 of the operating manual.

CHSI is including a certification by an Industrial Hygienist concerning risks associated with the emissions from the lamp crushing machine to off-site receptors. Also included is a copy of the notification sent to the facility Mailing List Addresses and the Legal Notice published in the Daily Southtown.

If you have any questions concerning this information, please contact me at (773) 646-6202, x233.

Sincerely,

James R. Laubsted
Facility Compliance Manager

CleanHarbors
ENVIRONMENTAL SERVICES, INC.

11800 South Stony Island Avenue
Chicago, IL 60617
773.646.6202
Fax 773-646-6381
www.cleanharbors.com

September 9, 2004

Mr. Mark A. Schollenberger, P.E.
Bureau of Land – Permit Section
Illinois Environmental Protection Agency
1021 North Grand Avenue East
Springfield, IL 62702

Dear Mr. Schollenberger:

Clean Harbors Services, Inc. (CHSI) is submitting additional information concerning its application for a Class 3 permit modification for the addition of a lamp crushing machine for Building 25.

An engineer certification indicating the lamp crushing machine is fit for its intended use is being sent under separate cover.

Enclosed is a proof of publication of the public notice.

It is noted in the operating manual for the lamp crusher that plastic coated lamps must not be placed directly on feed conveyor #1. Plastic will be removed from these lamps either manually (cut with a razor knife) or by use of the de-globing chamber.

In Attachment 5 (Compliance Test Report), in the Summary of Results (page 2) of mercury emissions, is the statement "The allowable emission rate is 1.1 X 10(-5) lb/h." This allowable emission rate is the permit limit for this unit at Clean Harbors Cincinnati, OH facility.

In the application, CHSI stated one drum would be connected to the unit for calcium phosphate powder with mercury. The actual breakdown is as follows:

Material	Container
Glass	Flex-bin or metal hopper
Glass	5-gallon pail
Glass Fines	55-gallon drum
Phosphate powder/mercury	55-gallon drum
Phosphate powder/mercury	55-gallon drum
Metal	Cubic yard box or 55-gallon drum

The locations are shown in the enclosed drawing. Each drum of hazardous waste will be counted toward the 73-drum storage capacity of the Unit 25 Alkaline Bay.

If you have any questions or require more information concerning the lamp crusher, please contact me at (773) 646-6202, x233.

Sincerely,

James R. Laubsted
Facility Compliance Manager

CERTIFICATE OF PUBLICATION

DAILY SOUTHTOWN, INC., NEWSPAPERS

The undersigned corporation does hereby certify that it is the publisher of the DAILY SOUTHTOWN that said DAILY SOUTHTOWN is a secular newspaper that has been published daily in the County of Cook and State of Illinois, continuously for more than one year prior to the first publication of the notice appended, and is of general circulation throughout the said County and State and that - it is a newspaper as defined in "An Act to Revise The Law in Relation to Notices". As amended by an Act approved July 17, 1959 - Illinois Complied Statutes, Chapter 715 (ILCS 5/0.01 *et seq.*)

That the notice appended was published in the DAILY SOUTHTOWN, INC., on

APRIL 22, 2004

IN WITNESS WHEREOF, The DAILY SOUTHTOWN, INC., has caused this certificate to be signed and its corporate seal affixed hereto at Tinley Park, Illinois, this 22[ND] day of APRIL, A. D., 2004.

By: ______________________

Authorized Agent

LEGAL NOTICE

Notice is given to all interested persons that Clean Harbors Services, Inc. (CHSI), a wholly-owned subsidiary of Clean Harbors Inc. and a permitted hazardous waste treatment, storage and transfer facility located at 11800 South Stony Island Avenue in Chicago, IL has filed a Class 3 permit modification with the Illinois Environmental Protection Agency (IEPA) for authorization to add a lamp crushing machine to Unit 25 to crush fluorescent and HID light bulbs allowing volume reduction as well as separation of materials for recycling.

Pursuant to 35 IAC 703.82, CHSI announces a 60-day comment period beginning April 22, 2004 and ending June 21, 2004 during which all interested parties have the opportunity to review the modification request and to submit written comments to the IEPA. CHSI will hold an informational public meeting open to all interested persons to discuss the proposed modification. The meeting will be held on May 18, 2004 from 7:00-8:00 P.M. at the Chicago Public Library - Hegewisch Branch at 3048 E. 130th Street in Chicago, IL.

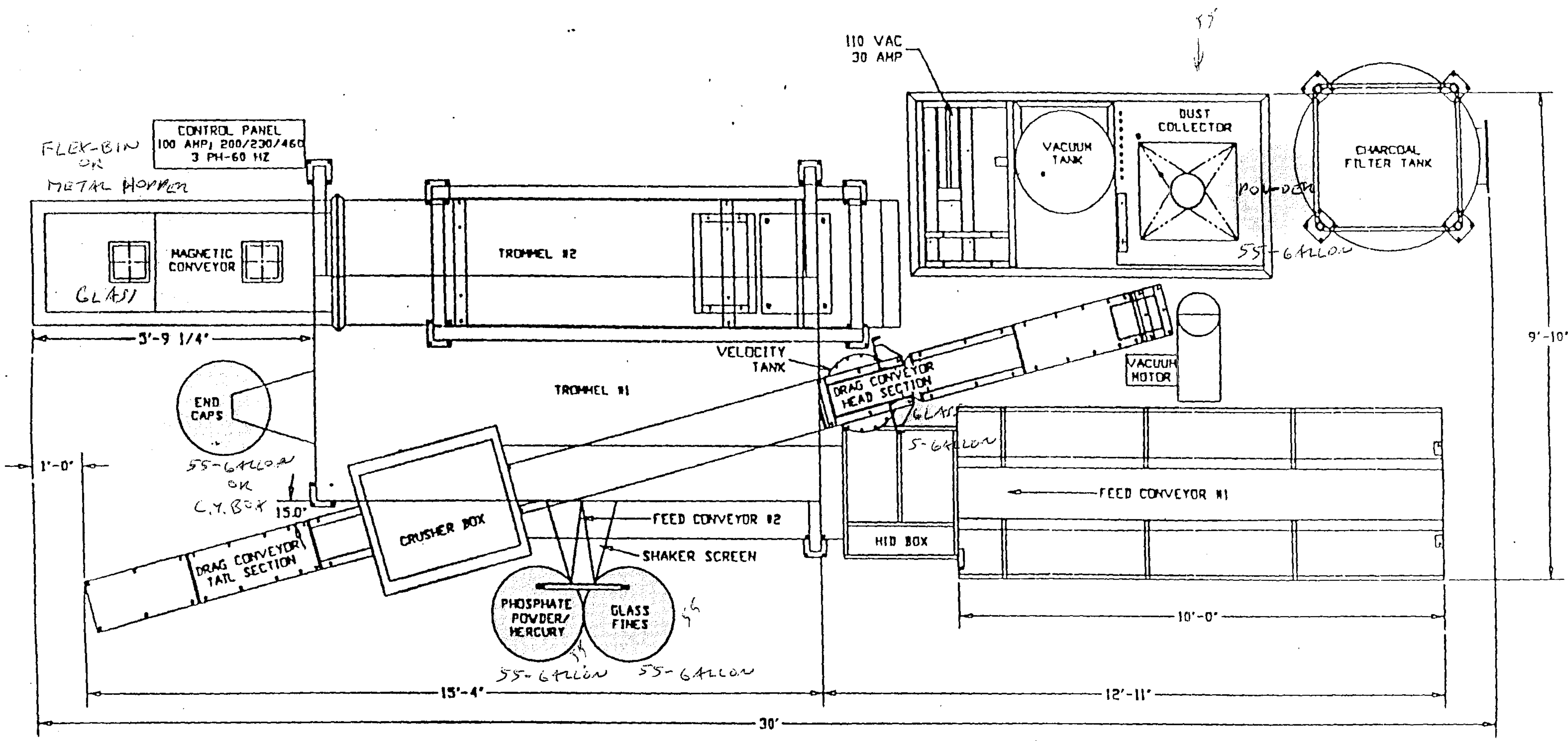
Copies of the modification request are available for review during normal business hours at CHSI's business office at 11800 S. Stony Island Avenue in Chicago, IL, at IEPA's office in Springfield, IL, or the Chicago Public Library - Hegewisch Branch. The permittee's compliance history during the life of the permit being modified is available from the Agency contact person. Additional information on the modification request is available by contacting Mr. James R. Laubsted at Clean Harbors Services, Inc., 11800 S. Stony Island Avenue, Chicago, IL 60617, or at (773) 646-6202. Information regarding application viewing time and place, CHSI's existingpermit, applicable regulatory requirements, permit modification procedures and ChSI's compliance history may be obtained from Ms. Mara McGinnis, IEPA, 1021 North Grand Avenue East, Springfield, IL 62794-9276 or at (217) 524-3300.

County of Cook ,
State of Illinois
Subscribed and sworn to
before me this 22[ND] day of
APRIL, 2004

____

Notary Public

OFFICIAL SEAL
L. CONRAD
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES 3-2-2008



110 VAC
30 AMP
CONTROL PANEL
100 AMP; 200/230/460
3 PH-60 HZ
FLEX-BIN
OR
METAL HOPPER
MAGNETIC CONVEYOR
GLASS
TROMMEL #2
VACUUM TANK
DUST COLLECTOR
CHARCOAL FILTER TANK
POWDER
55-GALLON
3'-9 1/4"
VELOCITY TANK
TROMMEL #1
DRAG CONVEYOR HEAD SECTION
VACUUM MOTOR
END CAPS
55-GALLON
OR
C.Y. BOX
1'-0"
15.0"
GLASS
5-GALLON
CRUSHER BOX
FEED CONVEYOR #2
FEED CONVEYOR #1
SHAKER SCREEN
HID BOX
DRAG CONVEYOR TAIL SECTION
PHOSPHATE POWDER/ MERCURY
GLASS FINES
55-GALLON
55-GALLON
10'-0"
9'-10"
15'-4"
12'-11"
30'

MODEL LSS1

Appendix D-61

SOP for Addition of Dry Ice

To Roll-offs/Intermodals

Standard Operating Procedure for the Addition of Dry Ice into Roll-offs/Intermodals

Dry ice is required to be added to roll-offs/intermodals containing FB5 wastes during extreme weather conditions to prevent spontaneous combustion. FB5 wastes are solids which have greater than 5000 BTUs/lb and are non-dispersable monolithic solids or contain non-processable debris (e.g., paint filters).

Dry ice must be added when:

1. The expected high daytime temperature is at or above 90 degrees F.;
2. The expected low nighttime temperature is at or above 70 degrees F.; and
3. The expected high dewpoint is at or above 70 degrees F.

The addition of dry ice shall be conducted in Units B and Q1.

On each day when dry ice is required, containers must be inspected to ensure at least 25 pounds of dry ice is present.

On each day when dry ice is required, the container temperature must be monitored. If the container temperature exceeds 150 degrees F., additional dry ice must be added to the container even if 25 pounds of dry ice is already present.

Dry ice is delivered in 50 pound blocks and placed into a storage box. When needed, dry ice should be taken from the storage box, unwrapped, and placed on top of the waste.

Appendix D-62

SOP for the Wetting of Black Powder

CLEAN HARBORS, INC.
HEALTH & SAFETY GUIDELINES
WORK PLAN PREPARED FOR:

Wetting of Black Powder

CLEAN HARBORS SERVICES, INC.
11800 SOUTH STONY ISLAND AVENUE
CHICAGO, IL 60617

August 3, 2001

SAFETY GUIDELINES

I. EQUIPMENT

- **A.** 3M Pads
- **B.** Speedi Dry
- **C.** Overpack Jars
- **D.** Poly Bags
- **E.** Duct Tape
- **F.** Water
- **G.** Personal protective equipment (Poly coated tyvek, PVC gloves, Full face air purifying respirators, Chicken boots)

II. WORK AREA SET-UP

A. Materials/Operations Location

Perform work in designated staging area of unit R1.

B. Spill Containment

Cover work area with poly. Have non-sparking tools for spills.

C. Warning signs

Not applicable

D. Decon Area

Decon in work area after operation is complete.

III. EMPLOYEE BRIEFING

The following information shall be discussed with the crew performing the operation By the Crew Supervisor with assistance from Health and Safety (if necessary):

A. Emergency response for spills, fire, reactions, or employee exposure to Chemicals.

B. Health Effects/Signs, Symptoms of Exposure.

C. Work Plan Contents

Additional Information:

Black Powder could be shock sensitive if it contains insufficient water.
Dry solids are also flammable.

Black Powder - A deflagrating or low-explosive granular compound of sulfur, charcoal, and alkali nitrate, usually potassium or sodium nitrate.

Appearance:

Black granular powder.

Odor:

None

Short Term Exposure:

None

Long Term Exposure:

None

(FOR FURTHER INFORMATION, REFER TO MSDS OR CONTACT CLEAN HARBORS' HEALTH AND SAFETY DEPARTMENT)

IV. PERSONAL PROTECTIVE EQUIPMENT (PPE)

To ensure the well being of Clean Harbors employees, all employees opening containers must be in Level C protection.

Only the Clean Harbors' Manager of Occupational Health and Safety can authorize downgrading of personal protective equipment.

Level C includes:

Poly coated tyvek with hood
Chicken Boots
Latex Gloves
PVC Glvoes
Full face air purifying respirator

Employees handling closed containers can wear full face air purifying respirators with GMCH cartridges, PVC gloves, and work uniforms.

Other employees present assisting with paperwork or working on other projects can wear Level D protection.

Restrictions:

Level D includes:

Safety Glasses
Work Uniform
Steel toe boots

V. CONTROL MEASURES OPERATION PROCEDURES

A) Engineering Controls

B) Work Practices

1. Set up work area covered with poly.
2. Lay out material to be worked on in the work area while ensuring that aisle space is kept clear.
3. Select one pail at a time.
4. Repackage if necessary for proper shipping or disposal. Black powder must be packed in metal or heavy wall conductive plastic recepticles not over 450 grams(15.9 ounces) net capacity each. Check with disposal facility if stricter packaging requirements are necessary. All containers must be properly bonded and grounded.
5. Wet black powder with water (minimum of 20%).
6. Repackage inner packagings into an outer UN 4 G fiberboard box. The inner packagings must be arranged and protected so as to prevent simultaneous ignition of the contents. A maximum of 25 inner containers may be placed in the box.
7. Each package must be marked "black powder for small areas" and "NA0027". Each package must bear a flammable solid label and hazardous waste marking.

C) Standard Work Practices

1. Clean Harbors' Standard Safety Precautions/Work Practices shall be followed at all times to ensure contaminant concentrations and potential employee exposures are maintained as low as feasible.

2. When applicable, CHI's Lock-out/Tag-out Guidance Program shall be used to control hazardous energy sources. A copy of CHI's Lock-out/Tag-out Procedures is available.

3. All Electrical power for lighting and other equipment will be classified Class I Division II.

4. Clean Harbors procedures for work in flammable atmospheres must be followed at all times.

5. No hot work guidance allowed.

6. CHI heat stress program will be followed in order to reduce the potential for dehydration. The on-site daily safety meetings shall discuss the hazards of heat stress.

7. Hazards associated with slips, trips and falls shall be controlled by use of good housekeeping practices and buddy system.

8. No eating, drinking, or smoking, and/or applying cosmetics.

VII. CONTINGENCY PLAN

The following procedures should be followed in the event of a fire, spill reaction, or employee exposure.

A. In the event of a fire evacuate the facility and activate the facility contingency plan. Notify an Emergency Coordinator, the Compliance Manager and Health and Safety.

B. In the event of a spill, use non-sparking tools to collect spilled material. Notify an Emergency Coordinator, the Compliance Manager, and Health and Safety.

C. In the event of a reaction, halt all operations and notify an Emergency Coordinator, the Compliance Manager, and Health and Safety.

D. In the event of an employee exposure flush area with water for 15 minutes and notify an Emergency Coordinator, the Compliance Manager, and Health and Safety.

VIII. CLEAN-UP DECONTAMINATION

Decon should proceed as follows:

A. Exit work area to PPE doffing areas. Remove protective clothing, outer gloves, and boots. Unroll protective suit carefully to prevent contamination of employee uniform. Continue to wear respirators until all other PPE is removed and you are at the door.

B. Place removed protective clothing in receptable labeled for disposal.

C. Respiratory protection equipment shall be removed, cleaned, and disinfected in decon buckets. Inner gloves shall be worn during this procedure.

I have read and understand the contents of this work plan, and have had all relevant questions answered to my satisfaction. In addition, I agree to comply with the conditions/provisions outlined therein:

NAME (PRINT)	SIGNATURE	DATE

DOD Hazardous Materials Information System
DoD 6050.5-L
AS OF July 1998

FSC: 1376
NIIN: 00N037788
Manufacturer's CAGE: 51580
Part No. Indicator: A
Part Number/Trade Name: BLACK POWDER

==

General Information

==

Item Name:
Company's Name: GOEX INC
Company's Street: 1002 SPRINGBROOK AVE
Company's P. O. Box:
Company's City: MOOSIC
Company's State: PA
Company's Country: US
Company's Zip Code: 18507
Company's Emerg Ph #: 717-457-6724;800-424-9300(CHEMTREC)
Company's Info Ph #: 717-457-6724
Distributor/Vendor # 1:
Distributor/Vendor # 1 Cage:
Distributor/Vendor # 2:
Distributor/Vendor # 2 Cage:
Distributor/Vendor # 3:
Distributor/Vendor # 3 Cage:
Distributor/Vendor # 4:
Distributor/Vendor # 4 Cage:
Safety Data Action Code:
Safety Focal Point: N
Record No. For Safety Entry: 001
Tot Safety Entries This Stk#: 001
Status: SMJ
Date MSDS Prepared: 01SEP88
Safety Data Review Date: 29DEC92
Supply Item Manager:
MSDS Preparer's Name:
Preparer's Company:
Preparer's St Or P. O. Box:
Preparer's City:
Preparer's State:
Preparer's Zip Code:
Other MSDS Number:
MSDS Serial Number: BQWTX
Specification Number:
Spec Type, Grade, Class:
Hazard Characteristic Code: NK
Unit Of Issue:
Unit Of Issue Container Qty:
Type Of Container:
Net Unit Weight:

Report for NIIN: 00N037788

NRC/State License Number:
Net Explosive Weight:
Net Propellant Weight-Ammo:
Coast Guard Ammunition Code:

==

Ingredients/Identity Information

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Proprietary: NO
Ingredient: POTASSIUM NITRATE
Ingredient Sequence Number. 01
Percent: 70-76
Ingredient Action Code:
Ingredient Focal Point: N
NIOSH (RTECS) Number: TT3700000
CAS Number: 7757-79-1
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE
Other Recommended Limit: N/K

Proprietary: NO
Ingredient: CHARCOAL
Ingredient Sequence Number: 02
Percent: 8-18
Ingredient Action Code:
Ingredient Focal Point: N
NIOSH (RTECS) Number: FL7243500
CAS Number: 16291-96-6
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE
Other Recommended Limit: N/K

Proprietary: NO
Ingredient: SULFUR; (SULPHUR)
Ingredient Sequence Number: 03
Percent: 9-20
Ingredient Action Code:
Ingredient Focal Point: N
NIOSH (RTECS) Number: WS4250000
CAS Number: 7704-34-9
OSHA PEL: NOT APPLICABLE
ACGIH TLV: NOT APPLICABLE
Other Recommended Limit: N/K

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Physical/Chemical Characteristics

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Appearance And Odor: BLACK; NO ODOR.
Boiling Point: N/A
Melting Point: N/K
Vapor Pressure (MM Hg/70 F): N/A
Vapor Density (Air=1): N/A
Specific Gravity: SUPP DATA
Decomposition Temperature: N/K
Evaporation Rate And Ref: NOT APPLICABLE

Report for NIIN: 00N037788

Solubility In Water: HIGH
Percent Volatiles By Volume: N/A
Viscosity:
pH: 6-8
Radioactivity:
Form (Radioactive Matl):
Magnetism (Milligauss):
Corrosion Rate (IPY): N/K
Autoignition Temperature:

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Fire and Explosion Hazard Data

Flash Point: NOT APPLICABLE
Flash Point Method: N/P
Lower Explosive Limit: N/K
Upper Explosive Limit: N/K
Extinguishing Media: WATER.
Special Fire Fighting Proc: DO NOT FIGHT FIRES. EVACUATE AREA.
Unusual Fire And Expl Hazrds: DO NOT FIGHT FIRES. BLACK POWDER MAY DEFLAGRATE OR EXPLODE IN A FIRE WHILE CONFINED. EVACUATE AREA.

Reactivity Data

Stability: YES
Cond To Avoid (Stability): KEEP AWAY FROM HEAT, SPARKS & OPEN FLAME. AVOID IMPACT, FRICTION & STATIC ELECTRICITY.
Materials To Avoid: NOT APPLICABLE
Hazardous Decomp Products: NONE SPECIFIED BY MANUFACTURER.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT

Health Hazard Data

LD50-LC50 Mixture: NONE SPECIFIED BY MANUFACTURER.
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: NO
Route Of Entry - Ingestion: NO
Health Haz Acute And Chronic: NOT APPLICABLE
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: NOT RELEVANT
Signs/Symptoms Of Overexp: NOT APPLICABLE
Med Cond Aggravated By Exp: NOT APPLICABLE
Emergency/First Aid Proc: INGEST:CALL MD IMMEDIATELY (FP N). INHAL: REMOVE TO FRESH AIR. SUPPORT BREATHING (GIVE O*2/ARTF RESP) (FP N). EYES: IMMEDIATELY FLUSH W/POTABLE WATER FOR A MINIMUM OF 15 MINUTES, SEEK ASSISTANCE FROM MD (FP N). SKIN:FLUSH W/COPIOUS AMOUNTS OF WATER. CALL MD (FP N).

Report for NIIN: 00N037788

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: CAREFULLY PICK UP SPILLS W/NONSPARKING & NONSTATIC PRODUCING TOOLS. SUPERVISION ONLY BY A PERSON KNOWLEDGEABLE IN EXPLOSIVES.
Neutralizing Agent: NONE SPECIFIED BY MANUFACTURER.
Waste Disposal Method: DE-SENSITIZE BY DILUTING IN WATER. OPEN TRAIN BURNING OF SMALL UNCONFINED QUANTITIES. ALL PROCEDURES MUST BE IN COMPLIANCE W/ALL LOCAL, STATE & FEDERAL REGULATIONS.
Precautions-Handling/Storing: NO SMOKING. STORE IN A COOL, DRY PLACE.
Other Precautions: AFFECTED EQUIPMENT MUST BE THOROUGHLY WATER CLEANED BEFORE ATTEMPTING REPAIRS. USE ONLY NONSPARKING TOOLS.

Control Measures

Respiratory Protection: USE NIOSH/MSHA APPROVED RESPIRATOR APPROPRIATE FOR EXPOSURE OF CONCERN (FP N).
Ventilation: NOT REQUIRED IN OPEN, UNCONFINED AREAS.
Protective Gloves: IMPERVIOUS GLOVES (FP N).

Eye Protection: CHEMICAL WORKERS GOGGLES (FP N).
Other Protective Equipment: METAL FREE & NONSTATIC PRODUCING CLOTHES.
Work Hygienic Practices: WASH HANDS/SHOWER.
Suppl. Safety & Health Data: SPEC GRAV:1.7-1.82 (H*2O=1).

==
Transportation Data
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Transportation Action Code:
Transportation Focal Point:
Trans Data Review Date:
DOT PSN Code:
DOT Symbol:
DOT Proper Shipping Name:
DOT Class:
DOT ID Number:
DOT Pack Group:
DOT Label:
DOT/DoD Exemption Number:
IMO PSN Code:
IMO Proper Shipping Name:
IMO Regulations Page Number:
IMO UN Number:
IMO UN Class:
IMO Subsidiary Risk Label:
IATA PSN Code:
IATA UN ID Number:
IATA Proper Shipping Name:
IATA UN Class:
IATA Subsidiary Risk Class:
IATA Label:
AFI PSN Code:
AFI Symbols:
AFI Prop. Shipping Name:

Report for NIIN: 00N037788

AFI Class:
AFI ID Number:
AFI Pack Group:
AFI Label:
AFI Special Prov:
AFI Basic Pac Ref:
MMAC Code:
N.O.S. Shipping Name:
Additional Trans Data:

==
Disposal Data
==

Disposal Data Action Code:
Disposal Data Focal Point:
Disposal Data Review Date:
Rec # For This Disp Entry:
Tot Disp Entries Per NSN:
Landfill Ban Item:
Disposal Supplemental Data:
1st EPA Haz Wst Code New:
1st EPA Haz Wst Name New:
1st EPA Haz Wst Char New:
1st EPA Acute Hazard New:
2nd EPA Haz Wst Code New:
2nd EPA Haz Wst Name New:

2nd EPA Haz Wst Char New:
2nd EPA Acute Hazard New:
3rd EPA Haz Wst Code New:
3rd EPA Haz Wst Name New:
3rd EPA Haz Wst Char New:
3rd EPA Acute Hazard New:

==
Label Data
==

Label Required: YES
Technical Review Date: 29DEC92
Label Date: 22DEC92
MFR Label Number:
Label Status: G
Common Name: BLACK POWDER
Chronic Hazard: NO
Signal Word: DANGER!
Acute Health Hazard-None: X
Acute Health Hazard-Slight:
Acute Health Hazard-Moderate:
Acute Health Hazard-Severe:
Contact Hazard-None: X
Contact Hazard-Slight:
Contact Hazard-Moderate:
Contact Hazard-Severe:
Fire Hazard-None: X
Fire Hazard-Slight:
Fire Hazard-Moderate:

Report for NIIN: 00N037788

Fire Hazard-Severe:
Reactivity Hazard-None:
Reactivity Hazard-Slight:
Reactivity Hazard-Moderate:
Reactivity Hazard-Severe: X
Special Hazard Precautions: CLASS A EXPLOSIVE. KEEP AWAY FROM HEAT, SPARKS AND OPEN FLAMES. AVOID IMPACT, FRICTION, AND STATIC ELECTRICITY. ACUTE AND CHRONIC: NONE LISTED BY MANUFACTURER.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y
Label Name: GOEX INC
Label Street: 1002 SPRINGBROOK AVE
Label P.O. Box:
Label City: MOOSIC
Label State: PA
Label Zip Code: 18507
Label Country: US
Label Emergency Number: 717-457-6724;800-424-9300(CHEMTREC)
Year Procured:

WLS-TV
Attn: Public Service Director
190 N. State
Chicago, Illinois 60601

WBEZ Radio
Attn: Public Service Director
848 E. Grand Avenue
Chicago, Illinois 60611

WMAQ/AM
Attn: Public Service Director
455 North City Front Plaza
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US Army Corps of Engineers
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Illinois Department of Natural Resources
Office of Water Resources
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Business and Professional
People for the Public Interest
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Clem Balanoff
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Frank Machura, Sr.
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Chicago, IL 60633

The Cooper Family
12933 S. Muskegon
Chicago, IL 60633

Larry Tello
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The Taylor Family
10234 S. Van Vlissingen Rd.
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The Rev. Robert Klonowski
13101 S. Manistee

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APPENDIX B
LIST OF ACCEPTABLE CYLINDERS AT CLEAN HARBORS

CLEAN HARBORS OF CHICAGO, INC.
CYLINDER APPROVAL GUIDE

CONTENT

Acaraben (3)

Acetylen (Ethyne) (2.1)

Acetyl fluoride (Ethanyl flouride) (2.1)

Air (2.2)

Algerian condensate (3)

Allene (Dimethylene methane) (2.1)

Allylmagnesium bromide (3)

Allylmagnesium chloride (3)

Aluminum hydride trimethyl (3)
amine complex

Aluminum isopopoxide (3)

Amonipropane (3)

Ammonia (2.2)

Antimony pentachloride (8)

Antimony pentachloride
catalyst (8)

Antimony pentfluoride (8)

Antimony tribromide (8)

Antimony pentabromide (8)

Antimony trichloride (8)

Antimony trifluoride (8)

Antimony triiodide (8)

CONTENT

Aramite (T-butyl phenoxy-isopropyl-2-chloroethyl sulfite in solvent) (3)

ARCAT-71 catalyst (3)

Argon (2.2)

Arsenic pentafluoride (2.3)

Arsenic trichloride (6.1)

Arsenic trifluoride (2.3)
(Hazard zone A)

Baygon, PT-250 (Isopropoxyphenyl methyl carbamate) (3)

Benzene (3)

Benzyl mercaptan mixtures (3)

Benzylmagnesium chloride (3)

Bis (trifluoromethyl) peroxide (5.1)

Borazine (borazole) (3)

Boron tribromide (8)

Boron trichloride (2.3)

Boron triethyl (Triethyl borane) (4.2)

Boron trifluoride (2.3)

Bromine (8)

Bromine chloride (2.3)

Bromine pentafluoride (5.1)

Bromine trifluoride (5.1)

CLEAN HARBORS OF CHICAGO, INC.
CYLINDER APPROVAL GUIDE

CONTENT

Bromoacetone (6.1)

Bromochloridifluoromethane (Halon 1211) (2.2)

Bromodifluoro ethylene (2.1)

Bromoethane (ethyl bromide) (3)

Bromomethane (Methyl bromide) (2.3)

Bromotrifluoroethylene (2.1)

Bromotrifluoromethane (Halon 13B1) (2.2)

Butadiene (2.1)

Butane (2.1)

Butene (2.1)

Butene, CIS-2 (2.1)

Butene, Trans-2 (2.1)

Butanethiol mixtures (3)

Butyl ethyl magnesium (8)

Butyllithium (4.2)

Butylmagnesium chloride (3)

Butyl mercaptan mixtures (3)

Butyne (3)

Carbon dioxide (2.2)

Carbon disulfide mixtures (3)

Carbon monoxide (2.3)

Carbon tetrachloride (6.1)

CLEAN HARBORS OF CHICAGO, INC.
CYLINDER APPROVAL GUIDE

CONTENT

Carbon tetrafluoride (freon 14) (2.2)

Carbonyl fluoride (2.3)

Carbonyl sulfide (2.3)

Chloride (2.3)

Chlorine monofluoride (2.3)

Chlorine trifluoride (2.3)

Chlorpbezilate (3)

Chlorodifluoroacetonitrile (6.1)

Chlorodifluoroacetylfluoride (8)

Chlorodifluoroethane (2.1)

Chloropentafluoroacetone (2.2)

Chloropentafluoromethane (2.2)

Chloropentafluoropropene (2.2)

Chlorosulfonyl fluoride (8)

Chlorotrifluoroethane (2.2)

Chlorotrifluoroethylene (2.1)

Chlorodifluoromethane (2.2)

Chlorofluoromethane (2.1)

Chloroform (6.1)

CONTENT

Chloromethane anhydrous (2.1)
(methyl chloride) (R-40)

Chlorofluoroethylene (2.2)

Chloropentafluorothane (R-115) (2.2)

Chloropicrin (6.1)

Chlorotrifluoromethane (R-13) (2.2)

Chromyl chloride (5.1)

Cis-butene (2.1)

Cis-2-Butene (2.1)

Cyanogen bromide (6.1)

Cyclobutane (2.1)

Cyclohexane (3)

Cyclohexylmagnesium chloride (3)

Cyclopropane (2.1)

Cyclopentane (3)

Cyclopentylmagnesium chloride (3)

DDT (in solvent) (3)

DDVP (in solvent) (3)

Deuterium (2.1)

Deuterated ammonia (2.2)

CONTENT
Deuterium bromide (2.2)
Deuterium chloride (2.2)
Deuterium fluoride (2.2)
Deuterium iodide (2.2)
Deuterium selenide (2.1)
Deuterium sulfide (2.1)
Deuterium sulfide mixtures (2.1)
Dibromodifluoromethane (9)
Dibutylboron triflate (4.2)
Dibutylzinc (4.2)
Dichlorobenzene (6.1)
Dichlorodifluoroethylene (2.2)
Dichlorodifluoromethane (R-12) (2.2)
Dichlorofluoromethane (R-21) (2.2)
Dibutylaluminum hydride (3)
Dichloro-1,2-difluorethane 1,2 (2.2)
Dichloro-2,2difluroethane 1,1 (2.2)
Dichlorooctamethyltetrasiloxane (3)
Dichloromethyl silane (3)
Dichlorosilane (2.3)
Dichlorotetrafluoroethane (R-114) (2.2)

CONTENT

Dichlorotrifluoroethane (2.1)

Dichlorovinyl dimethyl phosphate
(in solvent) (3)

Dicumene chromium (4.2)

Dicyclopentadine (3)

Diethylaluminum chloride (4.2)

Diethylamine (3)

Diethylaluminum ethoxide (4.2)

Diethylaluminum hydride (4.2)

Diethylaluminum iodide (4.2)

Diethyl beryllium (4.2)

Diethylgallium chloride (4.2)

Diethyl dulfide borane mixtures (4.2)

Diethylzinc (4.2)

Difluoroethane (2.1)

Difluoroethylene 1,1 (2.1)

Difluoromethane (2.1)

Dihexylmagnesium (4.2)

Diisobutlyaluminum chloride (4.2)

Diisobutylaluminum hydride (3)

Dimethyl alane (dimethyl aluminum hydride) (3)

Dimethylaluminum chloride (4.2)

Dimethylamine (3)

CONTENT

Dimethylamine, anhydrous (3)

Dimethylamine, aqueous 25%, 40% (3)

Dimethylaminosulfur trifluoride (3)

Dimethyl cadmium (4.2)

Dimethyldifluorosilane (3)

Dimethyl disulfide mixtures (3)

Dimethyl ether (2.1)

Dimethyl methane (propane) (2.1)

Dimethyl methyl phosphonate (3)
(DMMP)

2,2-Dimethylpentane (3)

Dimethylpropane (2.1)

Dimethyl selenide (selenium) (4.2)

Dimethylsilane (4.2)

Dimethyl sulfide (3)

Dimethyl sulfide borane mixtures (4.2)

Dimethylzinc (4.2)

Di-n-butyl sulfide (3)

Di-t-butyl sulfide (3)

Diphenyldichlorosilane (8)

Disilane (4.2)

CONTENT

Dymel 22 (chlorodifluoromethane) (2.2)

Dodecyl mercaptan (3)

Dodecyl mercaptan mixtures (3)

Dymel 142 (Chlorodifluotoethane) (2.2)

Dymel 152 (Difluoroethane) (2.2)

Endosulfan (in solvent) (3)

Ethane (2.1)

Ethene (Ethylene) (2.1)

Ethanol (3)

Ethyl acetylene (2.1)

Ethyl alcohol (3)

Ethylaluminum chloride (4.2)

Ethylaluminum dichloride (4.2)

Ethylaluminum sesquichloride (4.2)

Ethylamine (Monothylamine) (2.1)

Ethyl bromide (Bromoethane) (3)

Ethyl chloride (R-160) (2.1)
(chloroethane)

Ethyl fluoride (2.1)

Ethylene (Ethene) (2.1)

Ethylenedibromide/methyl bromide (6.1)

Ethylene oxide (2.3)

Ethyl ether (3)

CONTENT

Ethyl magnesium bromide (3)

Ethyl mercaptan (3)

Ethyl methyl ether (3)

Ethyl silicate (3)

Ethyle thioethanol (3)

Ethylidene fluoride (Difluoroethane) (2.1)

Ethyne (Acetylene) (2.1)

Fluoroethane (3)

Fluoroethylene (6.1)

Fluoroform (Trifluoromethane) (2.2)

Fluoromethane (2.1)

Fluoromethyl propane (3)

Flourophenylmagnesium bromide (3)

Fluoropropene (3)

Forane 502 (see R502) (2.2)

Formic acid (8)

Freon 11 (trichlorofluoromethane) (2.2)

Freon 14 (carbon tetrafluoride) (2.2)

Freon 113 (trichlorotrifluoroethane) (2.2)

Freon 114 A (dichlorotetrafluoroethane) (2.2)

CLEAN HARBORS OF CHICAGO, INC.
CYLINDER APPROVAL GUIDE

CONTENT

Genetron 11 (trichlorodluoromethane) (2.2)

Genetron 12 (dichlorodifluoromethane) (2.2)

Genetron 23 *difluoroethane) (2.1)

Genetron 114 (dichlorotetrafluoroethane) (2.2)

Genetron 142-B (chlorodifluoroethane) (2.1)

Germanium tetrachloride (8)

Germanium tetrafluoride (8)

Halocarbon 113 (2.2)

Halocarbon 142B (2.2)

Helium (2.2)

Heptafluorobutyronitrile (2.1)

Heptafluorpropyl bromide (2.2)

Heptane (3)

Hexafluprpacetic anhydride (8)

Hexafluoroacetone (2.3)

Hexafluoroacetyl acetone (8)

Hexafluorobutadiene (3)

Hexafluorobutyne (3)

Hexafluorocyclobutyne

Hexafluorobutyronitrile

CLEAN HARBORS OF CHICAGO, INC.
CYLINDER APPROVAL GUIDE

CONTENT

Hexafluorocyclobutene (2.1)

Hexafluoroethane (R-116) (2.2)

Hexafluoroprntanedione (8)

Hexafluoropropane (2.2)

Hexafluoropropylene (2.2)

Hexafluoropropylene oxide (2.2)

Hexane (3)

Hexyl mercaptan mixtures (6.1)

Hydrazine, anhydrous (3)

Hydriodic acid (2.3)

Hydrogen (2.1)

Hydrogen bromide (2.3)

Hydrogen chloride (2.3)

Hydrogen iodide (2.3)
HYDROGEN SULFIDE (2.3)
I-Butyne (2.1)

Iodine pentafluoride (5.1)

Iodomethane (methyl iodode) (6.1)

Iodopentafluoroethane

CONTENT

Iodotrifluoromethane

Iron pentacarbonyl (6.1)

Isobutane (2.1)

Isobutene (3)

Isobutlylaluminum dichloride (3)

Isobutylene (2.1)

Isoocatne (3)

Isopentane (3)

Isopentene (3)

Isopentyne (2.1)

Isoprene (3)

Isoprenyl aluminum (4.2)

Isopropanol (3)

Isoprpyl amine (3)

Isopropylsulfonyl chloride (8)

Isopropyl aluminum (4.2)

K-Selectride (4.2)

KS-Selectride (4.2)

Krypton (2.2)

L-Selectride (4.2)

LS-Selectride (4.2)

Lethalaire (3)

CONTENT

Lethane (6.1)

Lindane (in solvent) (3)

Lithium aluminum hydride (4.3)

Lithium diisoproyl amide (4.2)

Lithium tributyl borohydride (4.2)

Lithium triethylborohydride (4.2)

Lithium tris-isopamylborohydride (4.2)

LPG Gas (Liquefied petroleum gas) (2.1)

Magala 0.5E catalyst (8)

Magala 7.5E catalyst (8)

Methyamine (2.1)

Methyl bromide (2.3)

Methyl butadiene (3)

Methyle butane thiol (3)

Methyl butene (3)

Methyl butyl ether (3)

Methyl chloride (chloromethane, R-40) (2.1)

Methyl chloroform (6.1)

Methyl cyclohexane (3)

Methyl cyclopentane (3)

Methyl ether (2.1)

Methyl fluoride (2.1)

CONTENT

Methyl iodide (iodomethane) (6.1)

Methyldichlorosilane (4.3)

Methylene fluoride (2.2)

Methyl hydrazine (6.1)

Methyl lithium (3)

MAPP gas (methylacetylene propadiene) (2.1)

Methyl mercaptan mixutres (n-butyl, n-hexylm n-octyl) (2.1)

Methane (2.1)

Methane, D-4 (2.1)

Methane thiol mixtures (2.1)

Methanol (3)

Methyl acetylene (propyne) (2.1)

Methylaluminum sesquichloride (4.2)

Methylethene (2.1)

Methylethylene (3)

Methyl magnesium bromide (3)

Methyl magnesium chloride (3)

Methyl magnesium iodide (3)

Methyl mercaptan (2.3)

Methyl mercaptan mixtures (2.3)

Methyl pentene (3)

Methylpropylene (2.1)

CLEAN HARBORS OF CHICAGO, INC.
CYLINDER APPROVAL GUIDE

CONTENT

Methylsilane (4.2)

Methyl trichlorosilane (3)

Methylamgnesium fluoride (3)

Methylrifluorosilane (3)

Methyl vinyl ether (2.1)

Methyl butanethiol (3)

Methyl butene (3)

2-Methyl-1-propene (2.1)

2-Methylpropane (2.1)

Mevinphos (in solvent) (3)

Molybdenum hexafluoride (8)

Monofluoroethylne (6.1)

Monomethylamine (2.1)

Naptha/petrileum distillates (3)

Natural gas (2.1)

Neopentane (dimethylpropane) (2.1)

Neon (2.2)

Niobium ethoxide (8)

Nitrogen (2.2)

CONTENT

Nitrogen trifluoride (2.2)

Nitrosyl chloride (2.3)

Nitrous oxide (2.2)

Nonafluoroisobutane (8)

N-Butane (2.1)

N-Propane (2.1)

Octafluorobutene (2.2)

Octafluorocyclo butane (2.2)

Octafluoropropane (2.2)

Octyl bicycloheptene dicarboximide (2.2)

Octyl mercaptan mixtures (in solvent) (3)

Oleum (6.1)

Oxalyl fluoride (8)

Oxygen (8)

Ozone (2.3)

CONTENT

Paraquat (2.2)

Parathion (in solvent) (3)

Pentaborane (4.2)

Pentachloro propane (2.1)

Pentafluorobutene-1 (2.1)

Pentafluorochloroacetone (6.1)

Pentafluoroethane (2.2)

Pentafluoroethyl iodide (8)

Pentafluoro propene (2.2)

Pentafluoropropionitrile (2.1)

Pentane (3)

Pentacluoroproprionyl chloride (8)

Perchloryl fluoride (2.3)

Perfluoroacetyl chloride (6.1)

Perfluorobutane (2.2)

Perfluoroisobutylene (6.1)

Perfluoro-2-butene (2.2)
(octafluorobut-2-ene)

Perfluorocyclobutane (2.2)
(octafluorocyclobutane)

Perfluorocyclobutene (2.2)

Perfluoroethane (2.2)

Perfluoroisobutene (6.1)

CONTENT

Perfluorodimethylcyclobutane (2.2)

Perfluoroomethoxy ethylene

Perfluoropropane (octafluoropropane) (2.2)

Perfluoropropene (2.2) (hexafluoropropylene)

Perfluoropropylene (2.2)

Phenyl magnesium bromide (3)

Phenyl magnesium bromide (3)

Phosphorous pentafluoride (2.3)

Phosphorous oxychloride (8) (phosphoryl chloride)

Phosphorous tribromide (8)

Phosphorous trifluoride (2.3)

Pinanyl mercaptan mixtures (6.1)

Pinene (3)

Piperonyl butoxide (6.1)

Pipron (6.1)

Propadiene (2.1)

Propane (2.1)

Propanesulfonyl chloride (8)

CONTENT

Propene (2.1)

1-Propene (2.1)

Propylene-1 (2.1)

Propylene (2.1)

Propylene oxide (3)

Propyne (2.1)

Pyrethrins (in solvent) (3)

Pyrethrum (in solvent) (3)

R40 (2.2)

R-115 (2.2)

R502 (2.2)

Resmethrin (in solvent) (3)

Rhenium hexafluoride (8)

Silane (2.1)

Silicon tetrabromide (8)

Silicon tetrachloride (8)

Silicon tetrafluoride (2.3)

Soldium aluminum diethyldihydride (3)
(in solvent)

Sodium chromate mixtures (5.1)

Stannic chloride (8)

CLEAN HARBORS OF CHICAGO, INC.
CYLINDER APPROVAL GUIDE

CONTENT

Stannous chloride (8)

Sulfur chloride (monochloride) (8)

Sulfur chloropentafluoride (6.1)

Sulfur dibromide (8)

Sulfur dichloride (2.3)

Sulfur dioxide (2.3)

Sulfur hexafluoride (2.2)

Sulfur monobromide (8)

Sulfur monochloride (chloride) (8)

Sulfur pentafluoride (8)

Sulfur oxide (8)

Sulfur tetrachloride (8)

Sulfur tetrafluoride (2.3)

Sulfur trioxide (8)

Sulfuric acid (8)

Sulfuryl chloride (8)

Sulfuryl chloride fluoride (8)

Sulfuryl fluoride (2.3)

TEPP (in solvent) (3)

Tetracarbonyl nickel (nickel carbonyl) (6.1)

Tetrachloro ethylene (6.1)

CLEAN HARBORS OF CHICAGO, INC.
CYLINDER APPROVAL GUIDE

CONTENT

Tetrachloro silane (3)

Tetraethyl lead (6.1)

Tetraethyl (ortho) silicate (3)

Tetraethyl pyprophosphate (2.3)

Tetraethyl tin (in solvent) (3)

Tetrafluoroethane (2.2)

Tetrafluoro ethylene (2.2)

Tetrafluoroethylene with terpene inhibitor (2.1)

Tetrafluoromethane (2.1)

Tetrafluoro silane (silicon tetrafluoride) (2.2)

Tetramethyl methane (dimethyl propane) (2.1)

Tetramethyl silane (3)

Tetraphenyl silane (in solvent) (3)

Tetravinyl silane (3)

Thionyl bromide (8)

Thionyl chloride (8)

Tin tetrachloride (8)

Tin chloride (8)

Titanium tetrabromide (8)

Titanium tetrachloride (8)

Toluene (3)

Toluene thiol mixtures (6.1)

Trans-2-butene (2.1)

CONTENT

Trans-butene (2.1)

Tributylaluminum (4.2)

Tributylborane (4.2)

Tributyltin hydride (3)

Trichloroacetyl chloride (8)

Trichloroethane (6.1)

Trichlorofluoromethane (R-11) (2.2)

Trichloromethane Sulfonyl chloride (8)

Trichlorophenyl silane (3)

Trichloro n-decyl silane (3)

Trichlorosilane (4.3)

Trichlorotrifluoroethane (2.2)

Trichlorovinylsilane (3)

Triethoxyborane (3)

Triethyl arsenic (4.2)

Triethylaluminum (4.2)

Triethylamine (3)

Triethylborane (TEB) (4.2)

Triethylboron (4.2)

Triethylgallium (4.2)

Triethyloxoniumtetrafluoroborate (8)

Triethyl indium (4.2)

Triethyl phosphine (4.2)

CONTENT

Triethyl vanadate (4.2)

Tri-n-decylaluminum (4.2)

Trifluoroacetic anhydride (8)

Trifluoroacetone (3)

Trifluoroacetonutruke (2.1)

Trifluoroacetyl chloride (2.3)

Trifluoroacetyl fluoride (8)

Trifluorobromoethane (2.2)

Trifluoroethane (2.1)

Trifluoroethylene (2.2)

Trifluoromethane (2.2)

Trifluoromethyl hexafluoropropane (8)

Trifluoromethyl hydrofluorite

Trifluoromethyl hypofluorite (2.3)

Trifluoromethyliodide (2.2)

Trifluoromethyl propene 1,2 (3)

Trifluoronitrosomethane (2.2)

Trifluorophosphine (8)

Trifluoropropene (6.1)

Trihexyl aluminum (4.2)

Triisobutyl canadate (3)

Triisobutylaluminum (4.2)

Triisobutylborane (4.2)

CONTENT

Triisobutylboron (4.2)

Triisobutylgallium (4.2)

Triisohexylaluminum (4.2)

Triisopropylaluminum (4.2)

Trimethylacetyl chloride (8)

Trimethylaluminum (4.2)

Trimethylamine (2.1)

Trimethylamine (2.1)

Trimethyl amtimony (4.2)

Trimethylarsenic (arsine) (4.2)

Trimethyl bismuth (4.2)

Trimethyl borane (4.2)

Trimethylchlorosilane (3)

Trimethyl ethoxy silane (3)

Trimethylfluorosilane (3)

Trimethylgallium (4.2)

Trimethylindium (4.2)

Trimethyl methane (isobutane) (2.1)

Trimethyl pentane (3)

Trimethyl phosphine (4.2)

Trimethyl silane (4.2)

Trimethylstibine (4.2)

Trioctylaluminum (4.2)

CLEAN HARBORS OF CHICAGO, INC.
CYLINDER APPROVAL GUIDE

CONTENT

Tripropyl aluminum (4.2)

Trizone (6.1)

Tungsten bromide (8)

Tungsten chloride (8)

Tungsten fluoride (8)

Tungsten hexafluoride (2.3)

UCAT-A catalyst (4.2)

UCAT-E catalyst (4.2)

Vanadium oxytrichloride (8)

Vanadium pentafluoride (8)

Vanadium tetrachloride (8)

Vanadium trichloride (8)

Vanadium fluoride (8)

Vikane (sulfuryl fluoride) (8)

Vinyl bromide (2.1)

Vinyl chloride (2.1)

Vinyl fluoride (2.1)

Vinyl fluoride with d-limonen stabilizer (2.1)

Vinylidene chloride (3)

Vinylidene fluoride (2.1)

Vinyl methyl ether (2.1)

Xenon (2.2)

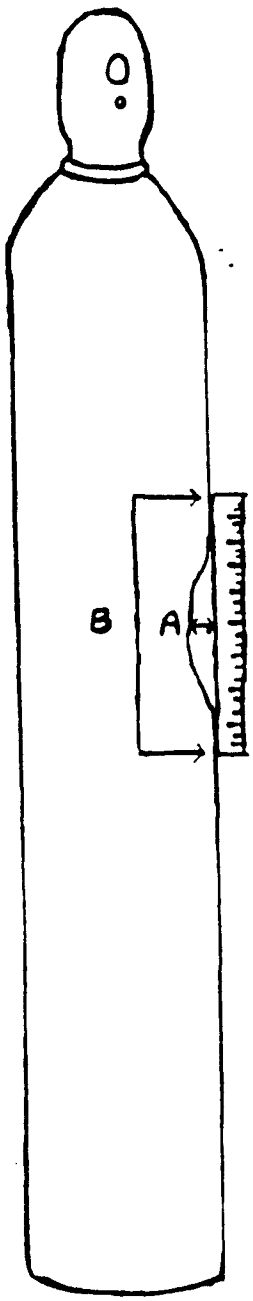
Warfarin (in solvent) (3)

CLEAN HARBORS OF CHICAGO, INC.
CYLINDER APPROVAL GUIDE

CONTENT

APPENDIX C

CYLINDER DENT MEASUREMENT



A= deepest dent point measurement

B= dent length

ex: B=10"
A=1.75"

B x 0.1= 10 x 0.1= 1.0

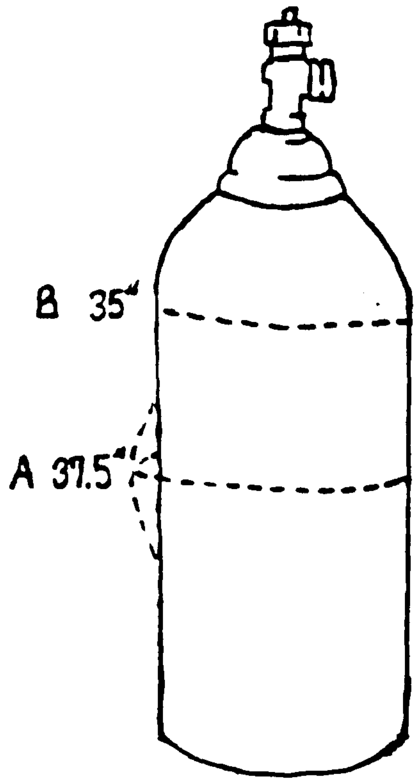
This cylinder would be considered non-DOT shippable due to wall weakening by the dent because
A>0.1B
1.75>1.0

APPENDIX D

CYLINDER BULGE MEASUREMENT

A=cylinder bulge circumference
B=normal cylinder circumference

circumference= $2\pi r = \pi d$
(can be used in absence of flexible tape measure)



B= 35"
A= 37.5"

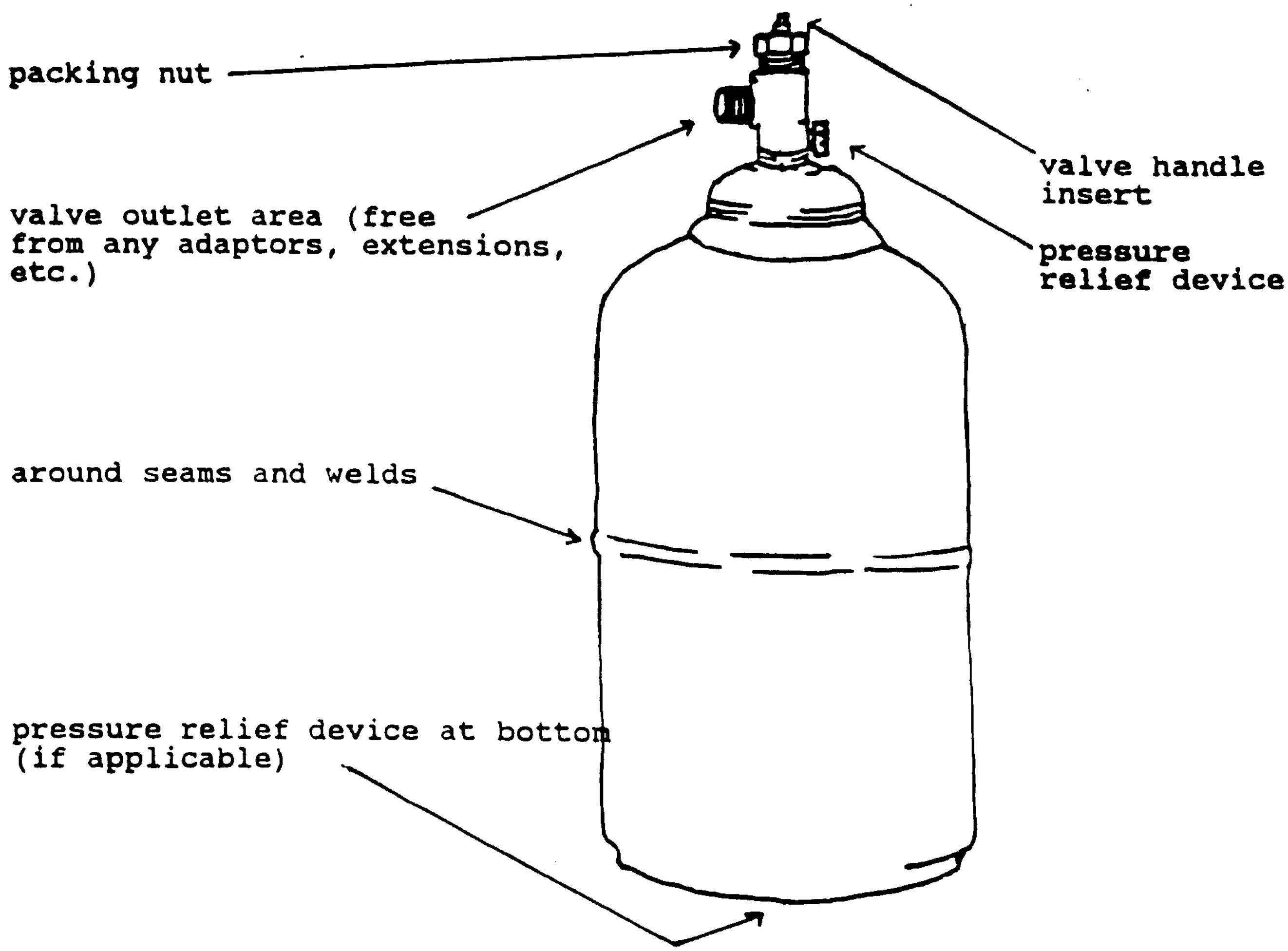
The maximum circumference "A" can be is: A + .01A

35 + 35(.01)= 35.35"

A= 37.5" therefore this cylinder is non-transportable per D.O.T. regulations

APPENDIX E

LEAK DETECTION CHECK AREAS



APPENDIX F

3/28/94 JG

APPROVAL # ______
PIECE SIZE ______
DRUM TRACKING # ______
DATE RECEIVED ______

CYLINDER EVALUATION FORM - 3/94

GENERATOR ______
ADDRESS ______
______
PHONE # ______

DATE ______
CHEMISTS ______
JOB # ______
TECH CONT. ______

CONTENTS LABELED (LIST % OF COMPONENTS) ______
PRODUCT # or LOT #, IF KNOWN CONTENTS ______
SUSPECTED ______

DIMENSIONS
DIA: ______
LGN: ______
CIR: ______
WT: ______

PHASE
GAS: ______
LIQ: ______
UNK: ______

COLORS
ON COLLAR: ______
TOP HALF: ______
BOT. HALF: ______

MARKINGS ______
______
______
______
______

SYMBOLS

VALVE PRESENT?
YES NO

VALVE COVER?
YES NO

CGA OUTLET #
______
______
______

PRESSURE RELIEF
ON VALVE ______
ON CYLINDER ______
NONE ______

RELIEF TYPE
PLUG ______
DISK ______
VALVE ______
OTHER ______
NONE ______

COMMENTS (ex. condition of cylinder and valve, # of cylinders, dents, bulges, corrosion):
______
______
______
______

SHIPPING INFO: ______
______
______
______

______ MANIFEST
______ BILL OF LADING

DOT LABELS: (FG)_____ (NFG)_____ (O)_____ (P)_____ (C)_____ (PG)_____ ( )_____

SUPPLIER: ______
ADDRESS: ______
______
PHONE #: ______

PRICE: ______
DISPOSAL CODE: ______

Can the cylinder be placed in the cylinder overpack?
(circle one) YES NO

LEAK TEST (circle one) P F

REMEMBER: ANY CYLINDER WITH THREADS ON THE COLLAR MUST HAVE A VALVE COVER FOR SHIPMENT.

APPENDIX G

TABLE A: Maximum Concentration (%) of a Flammable Component in a Nonflammable Binary Mixture
[Data from references 1,2, and 3 and by calculation.]

What are these ref's?

Flammable Component	Non-Flammable Component				
	N_2	CO_2	He	Ar/Kr/Ne/Xe	SF_6
Acetone	7.8	13.30	5.36	4.06	11.26
Acetylene	3.2	4.80	2.17	1.63	4.72
Ammonia	15.00	20.93	10.57	8.11	20.93
Amylene	1.50	2.23	1.01	0.76	2.23
Arsine	5.8	8.45	3.96	2.99	8.45
Benzene	4.5	7.10	3.06	2.30	6.60
Butadiene	4.5	8.10	3.06	2.30	6.60
Butane	5.6	10.40	3.82	2.88	8.17
Butane-Iso	1.83	2.72	1.23	0.92	2.72
Butene-1	4.7	8.2	3.20	2.41	6.89
Butene-2	1.85	2.75	1.25	0.93	2.75
Butene-Iso	5.5	9.50	3.75	2.83	8.03
Butyl Benzenes	0.82	1.22	0.55	0.41	1.22
Carbon Disulfide	2.7	5.10	1.83	1.37	4.00
Carbon Monoxide	20	32.00	14.35	11.11	27.27
Carbonyl Sulfide	12	16.98	8.37	6.38	16.98
Chlorine Monoxide	23.50	31.54	17.07	13.31	31.54
1,1,1 - Chloro-Difluoroethane	9	12.92	6.21	4.71	12.92
Chlorotrifluoroethylene	8.4	12.09	5.79	4.38	12.09
Cyanogen	6.15	8.95	4.21	3.17	8.95
Cyclobutane	1.8	2.68	1.21	0.91	2.68
Cyclohexane	1.26	1.88	0.85	0.63	1.88
Cyclohexene	0.96	1.43	0.65	0.48	1.43
Cyclopropane	7.3	12.40	6.73	3.79	10.56
Decane	0.77	1.15	0.52	0.39	1.15
Diborane	0.8	1.20	0.54	0.40	1.20
Dichlorosilane	4.1	6.03	2.78	2.09	6.03
Diethyl Benzene	0.80	1.20	0.54	0.40	1.20
Diethyl Ether	3.4	6.80	2.30	1.73	5.01
Diethyl Pentane	0.74	1.11	0.50	0.37	1.11
Dimethyl Amine	2.8	4.14	1.89	1.42	4.14
Dimethyl Butanes	1.2	1.79	0.81	0.60	1.79
Dimethyl Ether	12.5	17.65	8.74	6.67	17.65
2,2 - Dimethylpropane	1.38	2.06	0.93	0.69	2.06
Dodecane	0.6	0.90	0.40	0.30	0.90
Ethane	12	16.98	8.37	6.38	16.98
Ethanol	14.8	20.67	10.43	7.99	20.67
Ethyl Benzene	0.99	1.48	0.67	0.50	1.48
Ethyl Chloride	3.85	5.67	2.61	1.96	5.67
Ethyl Cyclobutane	1.24	1.85	0.83	0.62	1.85
Ethyl Cyclohexane	0.95	1.42	0.64	0.48	1.42
Ethyl Cyclopentane	1.10	1.64	0.74	0.55	1.64

Flammable Component	Non-Flammable Component				
	N_2	CO_2	He	Ar/Kr/Ne/Xe	SF_6
Ethyl Ether	1.90	2.82	1.28	0.96	2.82
Ethyl Formate	2.70	14.28	1.83	1.37	4.00
Ethylamine	3.5	5.16	2.37	1.78	5.16
Ethylene	6	9.90	4.10	3.09	8.74
Ethylene Oxide	3.00	9.00	2.03	1.52	4.43
Heptanes	1.1	1.64	0.74	0.55	1.64
Hexanes	3.88	6.95	2.63	1.98	5.71
Hydrogen	5.7	8.80	8.70	2.93	8.31
Hydrogen Cyanide	6	8.74	4.10	3.09	8.74
Hydrogen Sulfide	4.3	6.31	2.92	2.20	6.31
Methane	14.3	23.20	12.00	9.18	20.02
Methanol	14.5	22.90	10.20	7.82	20.28
Methyl Acetate	8.7	15.70	6.00	4.55	12.51
Methyl Acetylene	1.7	2.53	1.15	0.86	2.53
Methyl Bromide	13.5	18.97	9.47	7.24	18.97
Methyl Chloride	10.75	15.30	7.47	5.68	15.30
Methyl Cyclohexane	1.15	1.72	0.77	0.58	1.72
Methyl Ethyl Ether	2	2.97	1.35	1.01	2.97
Methyl Ethyl Ketone	5.5	8.79	3.75	2.83	8.03
Methyl Formate	12	19.70	8.37	6.38	16.98
Methyl Mercaptan	3.9	5.74	2.65	1.99	5.74
Methyl Vinyl Ether	2.6	3.85	1.76	1.32	3.85
Methyl-3-Butene	4	7.16	2.72	2.04	5.88
Methylamine	4.95	7.25	3.37	2.54	7.25
Naphthalene	0.88	1.31	0.59	0.44	1.31
Nonane	0.83	1.24	0.56	0.42	1.24
Octane	0.95	1.42	0.64	0.48	1.42
Octane-Iso	0.98	1.46	0.66	0.49	1.46
Pentane	4.4	8.00	2.99	2.25	6.46
Pentane-Iso	1.35	2.01	0.91	0.68	2.01
Propadiene	2.6	3.85	1.76	1.32	3.85
Propane	6.5	12.20	4.45	3.36	9.44
Propanol	2.15	3.19	1.45	1.09	3.19
Propanol-Iso	2.00	2.97	1.35	1.01	2.97
Propene	5.6	10.50	3.82	2.88	8.17
Propylene Oxide	2.10	8.30	1.42	1.06	3.12
Silane	1	1.49	0.67	0.50	1.49
Styrene	1.1	1.64	0.74	0.55	1.64
Tetrafluoroethylene	11	15.64	7.65	5.82	15.64
Tetramethyl Pentane	0.77	1.15	0.52	0.39	1.15
Toluene	1.2	1.79	0.81	0.60	1.79
Trimethyl Amine	2	2.97	1.35	1.01	2.97
Vinyl Chloride	4	5.88	2.72	2.04	5.88
Vinyl Fluoride	2.6	3.85	1.76	1.32	3.85
Xylene	1.10	1.64	0.74	0.55	1.64

APPENDIX H

TABLE 6
TOXIC HAZARD ZONE LIMITS

COMPONENT	ZONE A > or = %	ZONE B > or = %	ZONE C > or = %	ZONE D > or = %	LC50 ppm	LC50 ORIGIN
AMMONIA	N/A	N/A	N/A	N/A	7338	LC50 RAT
ANTIMONY PENTAFLUORIDE	15.00	3.00	1.00	0.50	30	ISO
ARSENIC PENTAFLUORIDE	10.00	2.00	0.67	0.40	20	ISO
ARSENIC TRIFLUORIDE	10.00	2.00	0.67	0.40	20	ISO
ARSINE	10.00	2.00	0.67	0.40	20	LC50 MUS time adj.
BIS-TRIFLUOROMETHYL PEROXIDE	5.00	1.00	0.33	0.20	10	ISO
BORON TRICHLORIDE	N/A	N/A	84.70	50.82	2541	LC50 RAT
BORON TRIFLUORIDE	N/A	80.60	26.87	16.12	806	LC50 RAT time adj.
BORON TRIBROMIDE	N/A	38.00	12.67	7.50	380	ISO
BROMINE CHLORIDE	N/A	29.00	9.67	5.80	290	Est. from Chlorine
BROMINE PENTAFLUORIDE	25.00	6.00	1.67	1.00	50	LClo
BROMINE TRIFLUORIDE	90.00	18.00	6.00	3.60	180	ISO
BROMOACETONE	N/A	26.00	6.67	5.20	260	ISO
BUTADIENE 1.3	N/A	N/A	N/A	N/A	220000	same as Cyclopropane
CARBON MONOXIDE	N/A	N/A	N/A	75.20	3760	LC50 RAT time adj.
CARBONYL FLUORIDE	N/A	36.00	12.00	7.20	360	LC50 RAT time adj.
CARBONYL SULFIDE	N/A	N/A	66.67	34.00	1700	LC50 MUS time adj.
CHLORINE	N/A	29.30	9.77	5.86	293	LC50 RAT
CHLORINE PENTAFLUORIDE	61.00	12.20	4.07	2.44	122	LC50 RAT
CHLORINE TRIFLUORIDE	N/A	29.90	9.97	5.98	299	LC50 RAT
CHLOROMETHANE	N/A	N/A	N/A	N/A	8300	ISO
CHLOROTRIFLUOROETHYLENE	N/A	N/A	66.67	40.00	2000	ISO
CHLOROTRIFLUOROPYRIDINE	N/A	N/A	N/A	N/A	5001	>5000 (DOT)
CYANOGEN	N/A	35.00	11.67	7.00	350	LC50 RAT
CYANOGEN CHLORIDE	40.00	8.00	2.57	1.60	80	LC50 RAT time adj.
CYCLOPROPANE	N/A	N/A	N/A	N/A	220000	ISO
DEUTERIUM CHLORIDE	N/A	N/A	N/A	62.40	3120	ISO
DEUTERIUM FLUORIDE	N/A	N/A	36.57	22.00	1100	ISO
DEUTERIUM SELENIDE	1.00	0.20	0.07	0.04	2	ISO
DEUTERIUM SULFIDE	N/A	71.00	23.67	14.20	710	ISO
DIBORANE	40.00	8.00	2.67	1.00	80	LC50 RAT time adj.
DIBROMODIFLUOROMETHANE	N/A	N/A	N/A	N/A	27000	ISO
DICHLORO-2-CHLOROVINYL-ARSINE	4.00	0.80	0.27	0.10	8	ISO
DICHLOROSILANE	N/A	31.40	10.47	6.28	314	LC50 RAT
DIETHYLAMINE	N/A	N/A	N/A	N/A	8000	ISO
DIETHYLZINC	5.00	1.00	0.33	0.20	10	ISO
DIMETHYLSILANE	N/A	N/A	N/A	N/A	5001	ISO not toxic (>5001)
DIPHOSGENE	1.00	0.20	0.07	0.04	2	ISO
ETHYLAMINE	N/A	N/A	N/A	N/A	16000	ISO
ETHYLDICHLOROARSINE	18.00	3.60	1.20	0.72	36	LC50 RAT time adj. (DC
ETHYLENE OXIDE	N/A	N/A	N/A	87.00	4350	LC50 RAT
FLUORINE	92.50	18.50	6.17	3.70	185	LC50 RAT
FLUOROETHANE	N/A	N/A	N/A	N/A	200000	ISO
GERMANE	N/A	57.10	19.03	11.42	571	LC50 RAT time adj.
HEPAFLUOROBUTYRONITRILE	5.00	1.00	0.33	0.20	10	ISO
HEXAFLUOROACETONE	N/A	47.00	15.67	9.40	470	LC50 RAT time adj.
HEXAFLUOROCYCLOBUTENE	N/A	N/A	N/A	N/A	5001	ISO not toxic (>5001)
HYDROGEN BROMIDE	N/A	N/A	95.33	57.20	2860	LC50 RAT
HYDROGEN CHLORIDE	N/A	N/A	N/A	62.40	3120	LC50 RAT
HYDROGEN CYANIDE	70.00	14.00	4.67	2.80	140	ISO & RTECS
HYDROGEN FLUORIDE	N/A	N/A	43.33	26.00	1300	LC50 RAT average
HYDROGEN IODIDE	N/A	N/A	95.33	57.20	2860	Est. same as HBr
HYDROGEN SELENIDE	1.00	0.20	0.07	0.04	2	LC50 GPG
HYDROGEN SULFIDE	N/A	71.20	23.73	14.24	712	LC50 RAT
HYDROGEN TELLURIDE	1.00	0.20	0.07	0.04	2	ISO
IODINE PENTAFLUORIDE	60.00	12.00	4.00	2.40	120	ISO

TOXIC HAZARD ZONE LIMITS

COMPONENT	ZONE A > or = %	ZONE B > or = %	ZONE C > or = %	ZONE D > or = %	LC50 ppm	LC50 ORIGIN
IODOTRIFLUOROMETHANE	N/A	N/A	N/A	N/A	5001	ISO not toxic (>5001)
METHYL BROMIDE	N/A	85.00	28.33	17.00	850	LC50 RAT time adj.
METHYL CHLORIDE	N/A	N/A	N/A	N/A	8300	ISO
METHYL CHLOROSILANE	N/A	60.00	20.00	12.00	600	Est. as SIC2HCH3
METHYL DICHLOROSILANE	N/A	60.00	20.00	12.00	600	LC50 RAT time adj.
METHYL ISOTHIOCYANATE	N/A	83.50	21.17	12.70	635	LC50 RAT (DOT)
METHYL MERCAPTAN	N/A	N/A	45.00	27.00	1350	LC50 RAT time adj.
METHYL SILANE	N/A	N/A	N/A	N/A	5001	ISO not toxic (>5001)
METHYL VINYL ETHER	N/A	N/A	N/A	N/A	5001	ISO not toxic (>5001)
METHYLAMINE	N/A	N/A	N/A	N/A	7010	ISO
MUSTURD GAS (dichlorodiethyl sulfide)	2.00	0.40	0.13	0.08	4	ISO
NICKEL CARBONYL	10.00	2.00	0.67	0.40	20	ISO
NITRIC OXIDE	57.50	11.50	3.83	2.30	115	LC50 RAT for NO2
NITROGEN DIOXIDE	57.50	11.50	3.83	2.30	115	LC50 RAT
NITROGEN FLUORIDE OXIDE	N/A	N/A	N/A	N/A	5001	>5001 (RSPA not toxic)
NITROGEN TRIFLUORIDE	N/A	N/A	N/A	N/A	6700	ISO
NITROGEN TRIOXIDE	N/A	N/A	N/A	66.99	3350	calc N2O3=NO+NO2
NITROSYL CHLORIDE	17.50	3.50	1.17	0.70	35	LCLo CAT
OXYGEN DIFLUORIDE	1.30	0.26	0.09	0.05	2.6	LC50 RAT
OZONE	4.50	0.90	0.30	0.18	9	ISO
PENTABORANE	5.00	1.00	0.33	0.20	10	ISO
PENTAFLUOROPROPIONITRILE	5.00	1.00	0.33	0.20	10	ISO
PERCHLORYL FLUORIDE	N/A	77.00	25.67	15.40	770	LC50 RAT time adj.
PERFLUORO-2-BUTENE	N/A	N/A	N/A	N/A	12000	ISO
PHENYLCARBYLAMINE CHLORIDE	2.50	0.50	0.17	0.10	5	ISO
PHOSGENE	2.50	0.50	0.17	0.10	5	LC50 RAT time adj.
PHOSPHINE	10.00	2.00	0.67	0.40	20	LC50 RAT time adj.
PHOSPHOROUS PENTAFLUORIDE	N/A	26.00	8.67	5.20	260	Est. 1/5 of HF
PHOSPHOROUS TRIFLUORIDE	N/A	43.30	14.43	8.66	433	ISO
PROPYLENE OXIDE	N/A	N/A	N/A	N/A	7200	ISO
SELENIUM HEXAFLUORIDE	25.00	5.00	1.67	1.00	50	LC50 Rat adj.
SILANE	N/A	N/A	N/A	N/A	19000	ISO
SILICON TETRACHLORIDE	N/A	75.00	25.00	15.00	750	ISO
SILICON TETRAFLUORIDE	N/A	45.00	15.00	9.00	450	LC50 MUS
STIBINE	10.00	2.00	0.67	0.40	20	Est. same as AsH3
SULFUR CHLORIDE PENTAFLUORIDE	N/A	N/A	N/A	N/A	5001	>5001 (RSPA not toxic)
SULFUR DIOXIDE	N/A	N/A	84.00	50.40	2520	LC50 RAT
SULFUR TETRAFLUORIDE	20.00	4.00	1.33	0.80	40	LC50 RAT
SULFURYL FLUORIDE	N/A	N/A	N/A	60.40	3020	LC50 RAT
TELLURIUM HEXAFLUORIDE	12.50	2.50	0.83	0.50	25	LC50 RAT
TETRAETHYL LEAD	31.50	6.30	2.10	1.26	63	ISO
TETRAFLUORO HYDRAZINE	50.00	10.00	3.33	2.00	100	ISO
THIONYL CHLORIDE	N/A	N/A	39.20	23.52	1176	LC50 RAT (DOT)
TRICHLOROSILANE	N/A	N/A	34.67	20.80	1040	ISO
TRIETHYL ALUMINUM	5.00	1.00	0.33	0.20	10	ISO
TRIETHYL BORANE	N/A	N/A	46.67	28.00	1400	ISO
TRIFLUOROACETONITRILE	N/A	50.00	16.67	10.00	500	ISO
TRIFLUOROACETYLCHLORIDE	N/A	20.80	6.93	4.16	208	LC50 RAT Limit Test (DOT
TRIFLUOROCHLOROETHYLENE	N/A	N/A	66.67	40.00	2000	LC50 RAT adj. (DOT)
TRIFLUOROETHYLENE	N/A	N/A	66.67	40.00	2000	ISO
TRIMETHYLAMINE	N/A	N/A	N/A	N/A	7000	ISO
TRIMETHYLSILANE	N/A	N/A	N/A	N/A	5001	ISO not toxic (>5001)
TUNGSTEN HEXAFLUORIDE	N/A	21.67	7.22	4.33	217	Est. 1/6 of HF
VINYL BROMIDE	N/A	N/A	N/A	N/A	5001	ISO not toxic (>5001)
VINYL CHLORIDE	N/A	N/A	N/A	N/A	5001	ISO not toxic (>5001)
VINYL FLUORIDE	N/A	N/A	N/A	N/A	5001	ISO not toxic (>5001)

APPENDIX I

DESCRIPTION OF METHOD FOR DETERMINING GAS MIXTURE TOXICITY

Categories of Toxic Gas Mixtures

This standard classifies toxic gas mixtures into four categories. They are defined as follows:

(1) Category A-gases (mixtures) with an LC·50 ≤ 200 ppm,

(2) Category B-gases (mixtures) with an LC·50 ≤ 1000 ppm and >200 ppm,

(3) Category C-gases (mixtures) with an LC·50 ≤ 3000 ppm >1000 ppm, and

(4) Category D-gases (mixtures) with an LC·50 ≤ 5000 ppm >3000 ppm.

Canadian TDG Regulations [3.11(b)] classifies gases or gas mixtures as toxic if their LC·50 value is less than 5000 ppm. [2]

$$\frac{\text{ppm LC}\cdot 50\text{ of component}}{\text{actual ppm of component}} \times 1{,}000{,}000 = \text{LC}\cdot 50\text{ of mixture}$$

TWO OR MORE POISONOUS GASES IN MIXTURES WITH INERT:

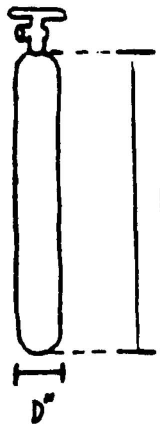
$$\frac{1}{\dfrac{\text{ppm toxic \#1}}{\text{ppm LC}\cdot 50\ \#1} + \dfrac{\text{ppm toxic \#2}}{\text{ppm LC}\cdot 50\ \#2} + \text{etc.}\ldots\ldots\ldots} \times 1{,}000{,}000 = \text{LC}\cdot 50\text{ ppm of mixture}$$

Percent of mix X 10,000 = ppm of component

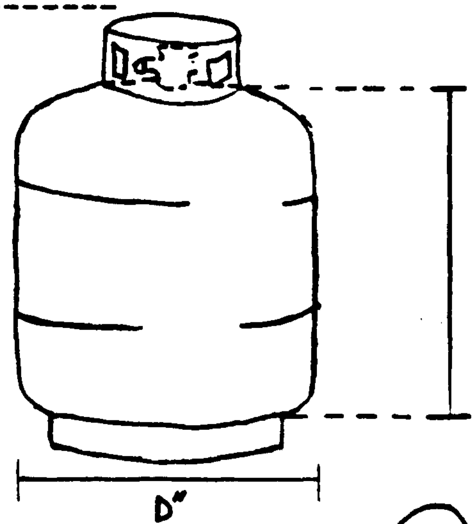
APPENDIX J

CYLINDER MEASUREMENT PARAMETERS

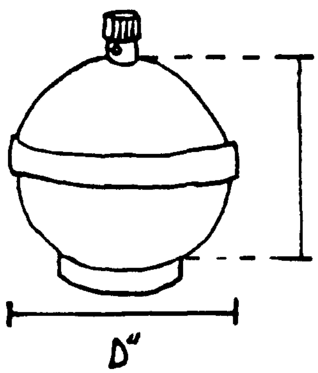
L"= length in inches
D"= diameter in inches



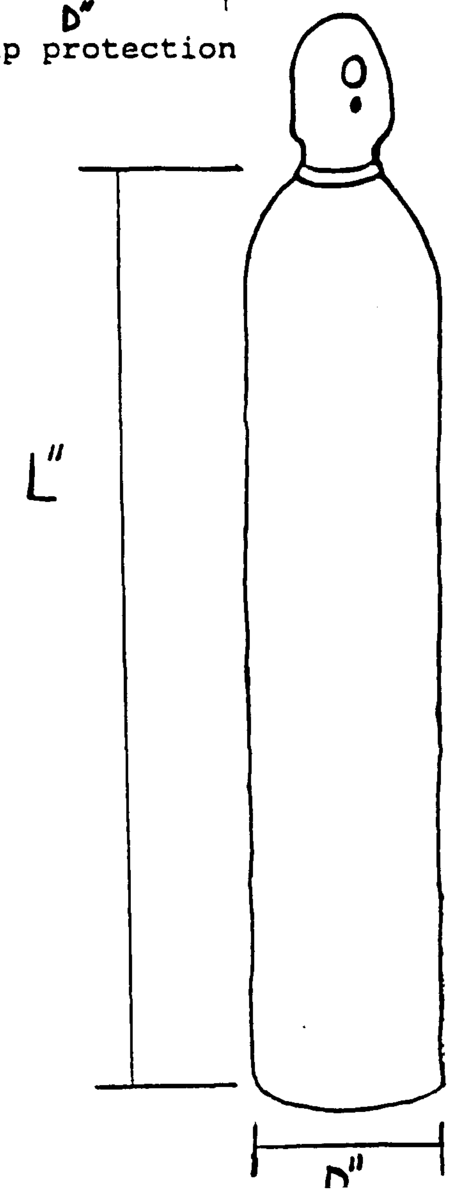
lecture bottle



base/cap protection



lecture sphere



full size (K-bottle)

APPENDIX K

COLOR MARKING OF COMPRESSED GAS CONTAINERS
INTENDED FOR MEDICAL USE

Gas Intended for Medical Use	United States Color	Canada Colour
Oxygen	Green	White[1]
Carbon Dioxide	Gray	Gray
Nitrous Oxide	Blue	Blue
Cyclopropane	Orange	Orange
Helium	Brown	Brown
Nitrogen	Black	Black
Air	Yellow[1]	Black and Whit
Gas Mixtures (other than mixtures of oxygen and nitrogen)	Color marking of mixtures shall be combination of colors correspondir to each component gas in accordanc with 4.3.	
Gas Mixtures of Oxygen and Nitrogen:		
19.5% to 23.5% Oxygen	Yellow[1]	Black and Whit
All Other Oxygen Concentrations	Black and Green	Pink

NOTE 1: Historically white has been used in the United States, and yellow use in Canada, to identify vacuum systems. Therefore, it is recommended that white not be used in the United States and yellow not be used ir Canada as a marking to identify containers for use with any medical gas.

Source for this info?

MATHESON GAS PRODUCTS

"Pure Gas Cylinder Color Coding"

Color coding, as listed, is peculiar to Matheson Gas Products and should be used only as a preliminary method of product identification. Many cylinders have an additional painted collar ring. This identifies various purities of the same product. Collar codes should be ignored when identifying cylinder contents. Product identification is positive only when the cylinder valve tag, stencilled name, valve outlet, and color code agree.

This list is by color. The color listed is on the top.

ALUMINUM -	
with Black	- Boron Trifluoride
with Brown	- Hydrogen Fluoride
with Green	- Phosphine
with Green/Black	- Arsine
with Green/Red	- Germane
with Pink	- Dichlorosilane
with White	- Silane
with Yellow	- Nitrous Oxide
BLACK -	- Ammonia
with Aluminum/Brown	- Fluorine
with Blue	- Phosgene
with Blue/Yellow	- Carbonyl Fluoride
with Gray	- Cyanogen
with Red	- Acetylene
with Yellow	- Isobutane
BLUE -	- Oxygen
with Black	- Ethane
with Brown	- Vinyl Bromide
with Green	- Methyl Fluoride
with Pink	- Hydrogen Iodide
with Red	- Vinyl Methyl Ether
with White	- Phosphorus Pentafluoride
with Yellow	- Hydrogen Bromide
BROWN -	- Carbon Dioxide
with Black	- Propane
with Green	- Methyl Mercaptan
with Pink	- Freon 14
with Red/White	- Chlorotrifluoroethylene
with Red/Yellow	- Freon 114
with White	- Methyl Bromide
with White/Black	- Cyclopropane
with Yellow	- Nitrogen Dioxide
with Yellow/Pink	- Nitric Oxide
GRAY -	- Hydrogen Sulfide
with Black	- Propylene
with Blue	- Allene
with Brown	- Freon 13B1
with Red	- Hydrogen Selenide
with White	- Carbonyl Sulfide

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GREEN -	- Sulfur Dioxide
with Aluminum/Brown	- Silicon Tetrafluoride
with Blue	- Freon 116
with Brown	- Sulfur Hexafluoride
with Gray	- Perfluoropropane
with Pink/Yellow	- Hexafluoropropylene
with Red	- Methane
with Yellow	- Argon
ORANGE -	- Ethylene Oxide
PINK -	- Nitrogen
with Black	- Neon
with Blue	- Air
with Gray	- Sulfur Tetrafluoride
with Yellow	- Deuterium
RED -	- Chlorine
with Black	- Methyl Chloride
with Blue	- Dimethyl Ether
with Brown	- Hydrogen Chloride
with Gray	- Ethyl Chloride
with Pink	- Octafluorocyclobutane
with White	- Xenon
with Yellow	- Freon 12
WHITE -	- Ethylene
with Black	- n-Butane
with Blue	- Dimethylamine
with Brown	- Monomethylamine
with Green	- Monoethylamine
with Pink	- Freon 23
with Red	- Carbon Monoxide
with Red/Yellow	- Freon 22
with Yellow	- Trimethylamine
YELLOW -	- Hydrogen
with Black	- Helium
with Blue	- 1-Butene
with Brown	- 1,3 Butadiene
with Gray	- trans-2-Butene
with Green	- Isobutylene
with Pink	- cis-2-Butene
with Red	- Boron Trichloride
with Red/Yellow	- Freon 13
with White	- cis and trans-2-Butene
NONE -	
shipped in SS cylinder	- Diallene
shipped in cans	- Freon 11 (Trichlorofluoromethane)
shipped in cans	- Freon 113
shipped in SS cylinder	- Tungsten Hexafluoride

MATHESON GAS PRODUCTS

"Pure Gas Cylinder Color Coding"

Color coding, as listed, is peculiar to Matheson Gas Products and should be used only as a preliminary method of product identification. Many cylinders have an additional painted collar ring. This identifies various purities of the same product. Collar codes should be ignored when identifying cylinder contents. Product identification is positive only when the cylinder valve tag, stencilled name, valve outlet, and color code agree.

Colors as listed will appear on cylinders from the top down.

Acetylene	- Black/Red
Air	- Pink/Blue
Allene	- Gray/Blue
Ammonia	- Black
Argon	- Green/Yellow
Arsine	- Aluminum/Green/Black
Boron Trichloride	- Yellow/Red
Boron Trifluoride	- Aluminum/Black
1,3 Butadiene	- Yellow/Brown
n-Butane	- White/Black
1-Butene	- Yellow/Blue
cis-2-Butene	- Yellow/Pink
trans-2-Butene	- Yellow/Gray
cis and trans-2-Butene	- Yellow/White
Carbon Dioxide	- Brown
Carbon Monoxide	- White/Red
Carbonyl Fluoride	- Black/Blue/Yellow
Carbonyl Sulfide	- Gray/White
Chlorine	- Red
Chlorotrifluoroethylene	- Brown/Red/White
Cyanogen	- Black/Gray
Cyclopropane	- Brown/White/Black
Deuterium	- Pink/Yellow
Dichlorosilane	- Aluminum/Pink
Dimethylamine	- White/Blue
Dimethyl Ether	- Red/Blue
Disilane	- None, stainless steel cylinder
Ethane	- Blue/Black
Ethyl Chloride	- Red/Gray
Ethylene	- White
Ethylene Oxide	- Orange
Fluorine	- Black/Aluminum/Brown
Freon 11 (Trichlorofluoromethane)	- None, shipped in cans
Freon 12 (Dichlorodifluoromethane)	- Red/Yellow
Freon 13 (Chlorotrifluoromethane)	- Yellow/Red/Yellow
Freon 13B1 (Bromotrifluoromethane)	- Gray/Brown
Freon 14 (Tetrafluoromethane)	- Brown/Pink
Freon 22 (Chlorodifluoromethane)	- White/Red/Yellow
Freon 23 (Fluoroform)	- White/Pink
Freon 113 (1,1,2 Trichlorotrifluoroethane)	- None, shipped in cans
Freon 114 (1,2 Dichlorotetrafluoroethane)	- Brown/Red/Yellow
Freon 116 (Hexafluoroethane)	- Green/Blue
Germane	- Aluminum/Green/Red
Helium	- Yellow/Black
Hexafluoropropylene	- Green/Pink/Yellow
Hydrogen	- Yellow
Hydrogen Bromide	- Blue/Yellow
Hydrogen Chloride	- Red/Brown
Hydrogen Fluoride	- Aluminum/Brown
Hydrogen Iodide	- Blue/Pink
Hydrogen Selenide	- Gray/Red
Hydrogen Sulfide	- Gray
Isobutane	- Black/Yellow
Isobutylene	- Yellow/Green
Methane	- Green/Red
Methyl Bromide	- Brown/White
Methyl Chloride	- Red/Black
Methyl Fluoride	- Blue/Green
Methyl Mercaptan	- Brown/Green
Monoethylamine	- White/Green
Monomethylamine	- White/Brown
Neon	- Pink/Black
Nitric Oxide	- Brown/Yellow/Pink
Nitrogen	- Pink
Nitrogen Dioxide	- Brown/Yellow
Nitrous Oxide	- Aluminum/Yellow
Octafluorocyclobutane (Halocarbon C318)	- Red/Pink
Oxygen	- Blue
Perfluoropropane	- Green/Gray
Phosgene	- Black/Blue
Phosphine	- Aluminum/Green
Phosphorus Pentafluoride	- Blue/White
Propane	- Brown/Black
Propylene	- Gray/Black
Silane	- Aluminum/White
Silicon Tetrafluoride	- Green/Aluminum/Brown
Sulfur Dioxide	- Green
Sulfur Hexafluoride	- Green/Brown
Sulfur Tetrafluoride	- Pink/Gray
Trimethylamine	- White/Yellow
Tungsten Hexafluoride	- None, shipped in SS cylinder
Vinyl Bromide	- Blue/Brown
Vinyl Methyl Ether	- Blue/Red
Xenon	- Red/White

APPENDIX L

3. CGA REGISTERED SYMBOLS

CYLINDER SYMBOLS REGISTERED WITH THE COMPRESSED GAS ASSOCIATION, INC.

SORTED BY REGISTERED SYMBOL

LaRoche Industries Inc.,	A & CO
American Compressed Gases, Inc.	A - In a badge shape.
O. E. Meyer Co.	A819
Oxygen & Welding Supply Co., Inc.	A928
Liquid Carbonic Specialty Gas	ABC
Adirondack Bottled Gas Corp.	ABGC
ABSCO Distributing	ABSCO
Amarillo Coca-Cola Bottling Co.	ACCBC
Liquid Carbonic Specialty Gas	ACCORP
Allied Corp. Engd. Mat'ls. Sector	ACC-SCD
Allied-Signal Inc.	ACC-SCD
American Compressed Gases, Inc.	ACG
Airco Gases	ACME
Liquid Carbonic Specialty Gas	ACME OX
Airco Gases	ACMEGAS
General Welding Supply Co.	ADAM
Airco Gases	AEM
Airco Gases	AEMM
AETNA Gas Products, Inc.	AETNAGAS
Approved Fire Protection Co.	AFPCO
Acetylene Gas Company	AG - G in the lower half of the "A".
AGA Gas, Inc.	AGA
AGA Gas, Inc.	AGA USA
AGA Gas, Inc.	AGAGAS
AGA Gas, Inc.	AGAS
Air Products & Chemicals, Inc.	AGCD
Liquid Carbonic Inc.	AGS
Liquid Carbonic Specialty Gas	AGS
AIFA Products/Morton Thiokol, Inc.	AIFA PRODUCTS
American Industrial Gases, Inc.	AIGI
Liquid Carbonic Specialty Gas	AIGI
Air Products & Chemicals, Inc.	AIRWELD

Akron Oxygen and Supply Co., Inc.	AKROX
Air Products & Chemicals, Inc.	ALDAN
Liquid Carbonic Specialty Gas	ALL STATE
All Pure Chemical Co., Inc.	ALLP
Allied Corp. Engd. Mat'ls. Sector	ALL-SIG
Canadian Liquid Air Ltd.	ALS
American Oxygen Company, Inc.	AMERCO
Airco Gases	AMGAS
Airco Gases	AMGS
Airco Gases	AMWSCO
Andrus Equipment Corp.	ANDRUS
The Ansul Company	ANSUL
Liquid Carbonic Specialty Gas	AOS
Airco Gases	AOXCO
Liquid Carbonic Specialty Gas	AO&AC
Acetylene Products Co., Inc.	APC
Liquid Carbonic Specialty Gas	APEX
Air Products & Chemicals, Inc.	APROINC
Airco Gases	ARCO
Liquid Carbonic Specialty Gas	ARCO
Airco Gases	ARCOM
Arco Welding Supply Co., Inc.	ARCOWS
AGA Gas, Inc.	AREA CO
LaRoche Industries Inc.	ARMOUR AMMONIA DIVISION
LaRoche Industries Inc..	ARMOUR AMMONIA WORKS
Liquid Carbonic Specialty Gas	ARROWELD
Ashland Chemical Company	ASHCCO
Arthur's Sales & Service, Inc.	ASSKA
Wilson Oxygen and Supply Co., Inc.	AS&MC
Potomac Airgas	AS&SCO
Athens Welding Supply	ATHENSWS
Ansul Tank Manfacturing	ATM
Air Products & Chemicals, Inc.	ATSCO
Airco Gases	AUSCO
Midwest Welding Supply, Inc.	AWC
Arizona Welding Equipment Co.	AWECO
MG Industries	AWISCO
AGA Gas, Inc.	AWL
AWISCO, Inc.	AWSC, INC

Big Three Lincoln Alaska Inc.	AWSCORP
Air Products & Chemicals. Inc.	AWSCSC
Air Products & Chemicals. Inc.	AWSSAT
American Welding Supply	AWS-SJ
Amerex Corporation	AX
Arizona Welding Equipment Co.	AZ WELDING
A & A Welder's Supply, Inc.	A.A.W.S.I.
Acetylene Gas Company	A.G.C.
Welding Equip. & Supply Co.	B DAVIS
General Gases & Supplies Corp.	B443
BWS. Inc.	Bakersfield Welding Supply
Liquid Carbonic Inc.	BAKERSFIELD WELDING SUPPLY
Airco Gases	BALAAM
Air Products & Chemicals. Inc.	BALBACH
Big Three Industries. Inc.	BAO
Barclay Company	BARCO
B. Barer & Sons, Inc.	BARER
Air Products & Chemicals. Inc.	BARNUM
California Welding Supply Co.	BAY
Liquid Carbonic Specialty Gas	BCCO
Air Products & Chemicals. Inc.	BCO
Brand Dry Ice Inc.	BDI
Airco Gases	BELCON
Bennett Welding Supply Corporation	BENNETT
Airco Gases	BERRY
Liquid Carbonic Specialty Gas	BGC
Bird Space Technology	BIRD
Air Products & Chemicals. Inc.	BISWLDG
Liquid Carbonic Specialty Gas	BLAUGAS
Wesco Redwood Inc.	BMV
Jones Chemicals, Inc.	BNH
AGA Gas, Inc.	BOCO
Liquid Carbonic Specialty Gas	BOCO
Airco Gases	BOND
Airco Gases	BONDS
Bob Smith Corp.	BOSMCO
MG Industries	BOSMET
Bower Ammonia & Chemical Co.	BOWER
Metalweld, Inc.	BOWLING

Airco Gases	BOWS
Barton Welding Supply	BOWS
Liquid Carbonic Specialty Gas	BOXCO
People Greeters	BPG
National Welders Supply Co., Inc.	BRAWEL
Brooks Welding Supply Company	BRWELCO
Big Three Lincoln Alaska Inc.	BTLA
Big Three Industries, Inc.	BTWECO
Big Three Industries, Inc.	BTWSCO
Buckeye Corporation	BUCK
Buckeye Welder Services, Inc.	BUCK-WELD
MG Industries	BUCO
Airco Gases	BUDS
AGA Gas, Inc.	BURCO
AGA Gas, Inc.	BURDOX
Butler Gas Products Co.	BUTGAS
Buffalo Welding Supply Co., Inc.	BUWS
Potomac Airgas	BWI
Bail Welding Supplies	BWS
Brown Welding Supply, Inc.	BWSINC
Badger Welding Supplies, Inc.	BWSUP
Airco Gases	BWWSCO
AGA Gas, Inc.	BX
AGA Gas, Inc.	BYRD
Liquid Carbonic Specialty Gas	B&BCO
Union Carbide Canada Ltd.	C LINDE
Coyne Cylinder Company	C with diamond
Cascade Airgas Inc.	CAI
Caldwell Welding Supply Company	CALDWYN
Airco Gases	CALGAS
Airco Gases	CALOX
Airco Gases	CALOXLA
Cameron Welding Supply	CAMERON
Liquid Carbonic Inc.	CANADIAN ANAESTHETIC GASES LTD
Capitol Corporation	CAPITOL
Capitol Oxygen Company Limited	CAPOXY
Liquid Carbonic Specialty Gas	CARBO OXYGEN
Inweld Corporation	CARDINAL
Liquid Carbonic Specialty Gas	CCBO

Liquid Carbonic Specialty Gas	CCCO
General Welding Supply Co.	CCG CRYCO
Liquid Carbonic Specialty Gas	CCLTD
Big Three Industries, Inc.	CCOCO
Dempsey Enterprises	CDGS
Canadian Cylinder Co. Ltd.	CDNCYL
Union Carbide Canada Ltd.	CDOCO
Air Products & Chemicals, Inc.	CEB
Cee Kay Supply, Inc.	CEE-KAY
Liquid Carbonic Specialty Gas	CENCO
Cen-Tex Gas, Inc.	CENTEX
Airco Gases	CENTRAL
Hiram Rivera	CENTRO
Clovis Equipment & Supply Company.	CESCONM
Central Welding Supplies, Inc.	CEWESU
Liquid Carbonic Specialty Gas	CGC
Union Carbide Linde Division	CGC
Airco Gases	CGCO
Acetylene Gas Company	CHASECO
MG Industries	CHEM
Big Three Industries, Inc.	CHEM (Use in Hawaii Only)
Liquid Carbonic Specialty Gas	CHENEY
National Welders Supply Co., Inc.	CHESCO
Air Products & Chemicals, Inc.	CHWES
General Welding Supply Co.	CIGE CORP
Union Carbide Canada Ltd.	CLAPCO
Exodus, Ltd.	CLIG
Liquid Carbonic Specialty Gas	COCO
Liquid Carbonic Specialty Gas	COGASCO
Liquid Carbonic Specialty Gas	COLOX
Compositek Engineering Corporation	COMTEK
Liquid Carbonic Specialty Gas	CONNOX
Conwin Carbonic Co.	CONWIN
Continental Chemical Company	CON-O
Cook's Gas Inc.	COOKGAS
Corp Brothers, Inc.	CORP
Coss Welding Supply, Inc.	COSS
Liquid Carbonic Specialty Gas	COXCO
Coyne Cylinder Company	COYCO

Coyne Cylinder Company	COYNE
Union Carbide Canada Ltd.	CPOL
Liquid Carbonic Specialty Gas	CRCINC
Liquid Carbonic Specialty Gas	CRCO
Liquid Carbonic Inc.	CROWN CARBONIC LTD
Capital Welding Sup. Co. Inc.	CS - Capital Supply
Dempsey Enterprises	CWP
C. W. Pulver, Inc.	CWPULVER
Paul Carroll Welding Supply, Inc.	CWS
Airco Gases	CWSCI
Airco Gases	CWSCO
Coast Welding Supply	CWSH
Liquid Carbonic Inc.	CWSI
Crumpton Welding Sup. & Equip. Inc.	CWSTF
Union Carbide Canada Ltd.	CXLAPCO
Union Carbide Canada Ltd.	CXPOL
Liquid Carbonic Inc.	CYL. GAS
Union Carbide Linde Division	C&CCCo
C. W. Pulver, Inc.	C.W.P.
Dalox Welding Supply Co.	DALOX
Liquid Carbonic Specialty Gas	DCCLTD
Welder's Products & Service, Inc.	DDRCO
Air Products & Chemicals, Inc.	DELTA
Airco Gases	DELTA
Air Products & Chemicals, Inc.	DENTON
Denton Welding Supply	DENTON
Depke Welding Supplies, Inc.	DEPKE
Detroit Gas Products Co.	DGP
Liquid Carbonic Specialty Gas	DHS
Blackhawk Gases & Supply Co.	DJB
Liquid Carbonic Specialty Gas	DJJCO
Doansco Welding Supply	DOANSCO
General Welding Supply Co.	DOUTHOX
Airco Gases	DO&SCO
David Soda Dispensing Co.	DSDCO
Liquid Carbonic Inc.	DTL
E.I. du Pont de Nemours & Co.	DUCON
E.I. du Pont de Nemours & Co.	DUPP
Airco Gases	DUVAL

Airco Gases	DWECO
Welding Supply House, Inc.	D&HCO
Dixie Oxygen Co., Inc.	D-OX
Eagle Air Systems	EAGLE AIR SYSTEMS
Liquid Carbonic Specialty Gas	EAPCO
AGA Gas, Inc.	EASTEP
Welder's Products & Service, Inc.	EDOXKC
Ekohwerks Company	EKO
Earl's Welders Supply Company	ELMWS
Liquid Carbonic Specialty Gas	EMO
Etex, Inc.	ETEXING
East Texas Oxygen Company	ETOX
East Texas Oxygen Company	ETOX
Etox, Inc.	ETOXINC
Eureka Oxygen Co.	EUROX
Evans Welding Supply Co., Inc.	EWESCO
Air Products & Chemicals, Inc.	EWSCINC
Barton's Welding Supply	E&K
Airco Gases	FBWS
Fred E. Barnett Co.	FEBCO
Farmers Elevator Co.	FEC
Liquid Carbonic Specialty Gas	FFCCO
Liquid Carbonic Specialty Gas	FG & CC
Findley Welding Supply, Inc.	FWSINC
Potomac Airgas	FW&S
Air Products & Chemicals, Inc.	GARCRY
Liquid Carbonic Inc.	GAS DYNAMICS (CANADA) LTD
General Air Service & Supply Co.	GASES
AGA Gas, Inc.	GATEOX
Liquid Carbonic Specialty Gas	GCCO
General Gases & Supplies Corp.	GENERGAS
General Welding Supply Co.	GENWEL
General Welding Supply Co.	GENWES
Gerin Welding Sales, Inc.	GERIN
Gerin Welding Sales, Inc.	GERINSC
G & E Welding Supply Co. Inc.	GESUP
Liquid Carbonic Specialty Gas	GIG
AGA Gas, Inc.	GLENDOX
General Welding Supply Co.	GOCO

General Welding Supply Co.	GOCO
G. P. Modlish, Inc.	GPM
Northeast Airgas, Inc.	GRAVES
Greco Welding Supplies, Inc.	GRECO
Union Carbide Linde Division	GSC
Gas Systems, Inc.	GSI
Northeast Airgas, Inc.	GSOXY
General Cryogenics Corporation	GWCO
Airco Gases	GWECO
AGA Gas, Inc.	G&MC
General Welding Supply Co.	G.W.S.
Taylor-Wharton, Div. of HARSCO	H - in a circle.
Hammack Welding Supply, Inc.	HAMMACK
Airco Gases	HARCO
Riggs Welders Supplies, Inc.	HARCO
Haun Welding Supply Inc.	HAUN
Airco Gases	HAV-PON
A. G. Pond Co.	HAV-PON
Harris Calorific Sales, Inc.	HCS
Herring Welding Supply, Inc.	HERRING
McMillan Supply Company	HFM
Air Products & Chemicals, Inc.	HILLESCO
Hinely Air Products, Inc.	HINELY
Houston Lighting & Power Co.	HL&PCO
Hobart North Welding Supply, Inc.	HOBART-N
Big Three Industries, Inc.	HOCO
The Home Gas Corporation	HOMGAS
Holston Gases, Inc.	HOXCO
Hoprich Co. Inc.	HR
Huber Supply Co., Inc.	HUBCO
Hust Bros. Inc.	HUST
Union Carbide Linde Division	IAC
Union Carbide Linde Division	ICCO
ICG Liquid Gas Ltd.	ICG CORP.
ICI Americas Inc.	ICI-BCF
Island Equipment Co.	IECO (ISLAND)
IGO'S Welding Supply Co., Inc.	IGO
Oxygen Sales & Service, Inc.	IGS
Industrial Gas & Supply Co.	IGSCO

Liquid Carbonic Inc.	IMPOX
Oxygen Sales & Service, Inc.	IND GAS SUPPLY
Air Products & Chemicals, Inc.	IND SPEC
Industrial Welding Supplies Inc.	INDSI
Liquid Carbonic Inc.	INDUSTRIAL GASES & SUPPLIES LTD
Industrial Oxygen Co., Inc.	INOXCO
Interstate Welding Sales Corp.	INTERSTATE
Inweld Corporation	INWELD
Inweld Corp.	INWELD
Union Carbide Linde Division	IOC
Liquid Carbonic Specialty Gas	IOCO
Union Carbide Linde Division	IOCO
Big Three Industries, Inc.	IOSCO
Industrial Sales & Leasing	IOSCO
Airco Gases	IRVWELD
MG Industries	IRW
Industrial Safety Equip Co., Inc.	ISECO
Linde Gas of the West	IS&R
Industrial Welding Supply, Inc.	IWSCO
Industrial Welding Supply Inc.	IWSI
Sunox, Inc.	IWSINC
Acetylene Gas Company	I.A.P.
Interstate Ind. of New Jersey	I.I.I.
Acetylene Gas Company	I.S.
Acetylene Gas Company	I.W.
Jackson Welding Supply Co. Inc.	JACKWELS
Air Products & Chemicals, Inc.	JACS
Jackson Welding Supply Co., Inc.	JAWESCO
J A Welding Supply Co., Inc.	JAWS
Oxygen Service Company	JAYOX
Liquid Carbonic Specialty Gas	JBCO
Liquid Carbonic Specialty Gas	JEJR
James Oxygen & Supply Co.	JO2
James Oxygen & Supply Co.	JOS
Andrus Equipment Corp.	JUSTICE
MG Industries	JWS SHUTTE
Airco Gases	JWSC
AGA Gas, Inc.	JW&SCO
AGA Gas, Inc.	KANWELD

MG Industries	KAPCO
Nanco Inc.	KATIM
MG Industries	KC
Liquid Carbonic Specialty Gas	KCCO
Liquid Carbonic Specialty Gas	KCG
E.I. du Pont de Nemours & Co.	KCINC
Keen Welding Supplies, Inc.	KEENCO
Keen Compressed Gas Co., Inc.	KEENFLAME
AGA Gas, Inc.	KELSEY
MG Industries	KEYCG
Liquid Carbonic Specialty Gas	KICO
AGA Gas, Inc.	KKK
Keystone Metal Welding Supply, Inc.	KMWS
Liquid Carbonic Specialty Gas	KOCO
Welders Supply Service, Inc.	KOLL
Kirk Welding Supply	KWCO
Industrial Gas & Supply Co.	KWELSUP
Air Products & Chemicals, Inc.	KWSCO
Kirk Welding Supply	K-I-CO
Acetylene Gas Company	K.A.P.
Langdon Oxygen Company	LANGCO
Potomac Airgas	LAP
Union Carbide Linde Division	LAPCO
Air Products & Chemicals, Inc.	LAVIS
Layman Welding Supply Co.	LAYMAN
Liquid Carbonic Inc.	LCCL
Liquid Carbonic Specialty Gas	LCCO
Liquid Carbonic Inc.	LCI
Liquid Carbonic Specialty Gas	LCPORP
National Dry Ice	LDA
Town & Country Gas Service Inc.	LEVCO
Liquid Carbonic Specialty Gas	LEWS
Logan Hagan Welding Supply, Inc.	LHWS
Liquid Gas Co.	LIGACO
LaRoche Industries Inc.,	LII
Union Carbide Canada Ltd.	LINDE - with Oak Leaf
Union Carbide Linde Division	LINDE with Oak Leaf
Liquid Carbonic Specialty Gas	LIVOXCO
L. Miller & Son, Inc.	LM&S

Airco Gases	LOCO
Airco Gases	LRWS
Riggs Welders Supplies, Inc.	LRWSI
Lincoln Big Three, Inc.	L-B-3
Machine & Welding Supply Company	MACHCO
Airco Gases	MAGNOLIA
Matheson Gas Products	MC
Van Waters & Rogers Inc..	MCKC
Dempsey Enterprises	MFG
Magna-Fab Industries Inc.	MFL
MG Industries	MGB
MG Industries	MGI
MG Industries	MGIND
Airco Gases	MGPCO
MG Industries	MGSG
MG Industries	MGTP
Air Products & Chemicals, Inc.	MHOC
Midwest Bottle Gas Co.	MIDWEST
Mid-State Welding Supply, Inc.	MID-STATE WS
Miami Industrial Gases, Inc.	MIGINC
Airco Gases	MINEWELD
Michiana Welding Supply, Inc.	MISB
Modern Gas Service Corporation	MML
Mansfield Oxygen Corporation	MOA
Mansfield Oxygen Corporation	MOAS
Monarch Chemicals, Inc.	MOCH
Modern Gas Co., Inc.	MOGCO
National Welders Supply Co., Inc.	MOLONY
Moore's Welding Supply Co.	MOORE
Moore Bros.	MOORE BROS.
Moore Bros.	MOORES
Van Waters & Rogers Inc.	MORE
Missouri Oxygen Co.	MO-OX
Dempsey Enterprises	MPDSR
Arkansas Specialty Co., Inc.	MRS-MEA
Metrolina Welding Inc.	MWI
Mississippi Welding Supply, Inc.	MWI
Midwest Welding Supply, Inc.	MWSC
Monroe Welding Supply, Inc.	MWSCO

Midwest Welding Supply, Inc.	MWS-CHI
Liquid Air Corporation	M-FC
Airco Gases	M-WELD
Acetylene Gas Company	M.A.P.
Acetylene Gas Company	M.G.MS
National Ammonia Co.	NACO
Nanco Inc.	NANCO
Liquid Carbonic Inc.	NATOX
National Welding Supply, Inc.	NAWESCO
New Bedford Welding Supply, Inc.	NBWS INC.
MG Industries	NCG
Big Three Industries, Inc.	NCG (Use in Hawaii Only)
Liquid Carbonic Specialty Gas	NEGP
Liquid Carbonic Specialty Gas	NEWCO
Newton Welding Supply, Inc.	NEWWELD
New Hampshire Welding Sup. Corp.	NHWSCO
Northeast Airgas, Inc.	NHWSCO
Northeastern Ammonia Co.	NORAMCO
Nordan's Welding & Safety Supply	NORDAN'S
Northern Welding & Supply	NORWELD
Northern Welding & Supply Co.	NORWELD
General Welding Supply Co.	NORWESCO
N. Collins Cylinder Gas Co., Inc.	NOR-COL
Soda System	NSFCO
Nordan Smith Welding Supplies	NSWELD
Liquid Carbonic Specialty Gas	NVOC
National Welders Supply Co., Inc.	NWSCO
National Welders Supply Co., Inc.	NWSCO-SG
National Welding Supply Co. (Inc.)	NWS-FTW
AGA Gas, Inc.	OBWSCO
Airco Gases	OC&MCO
Airco Gases	OC&SEC
Liquid Carbonic Inc.	OGC
Liquid Carbonic Specialty Gas	OGC
Airco Gases	OMP
National Welders Supply Company, Inc.	OOWSCO
Jack B. Kelley Company	Orange w/silver strip/JBK Co.around neck
Air Products & Chemicals, Inc.	OREWS
AGA Gas, Inc.	OSAIR

Airco Gases	OSSCO
Oxygen Sales & Service, Inc.	OSSCO TACOMA WA
Oxygen Sales & Service, Inc.	OSSINC
OXARC, Inc.	OXARC
Big Three Industries, Inc.	OXCO
Industrial Gas & Supply Co.	OXSCO
Liquid Carbonic Inc.	OXY-WELD LTD.
Ozark Fire Entinguisher, Inc.	OZARK
Liquid Carbonic Specialty Gas	PACIFIC
Parrish Welding Supply, Inc.	PARRISH
L. V. Paul & Sons Equipment Corp.	PAULCO
Welding & Supply Co., Inc.	PBC-FLA
Potomac Airgas	PBM
Airco Gases	PCCA
Puritan-Bennett Corporation	PCGCO
Pennsylvania Engineering Company	PEN
P. G. Walker & Son, Inc.	PGW - PWG in a diamond.
Sunox, Inc.	PIEDWS
Liquid Carbonic Inc.	PINTSCH COMPRESSING CORPORATION
Patsems, Inc.	PJA
Plains Welding Supply, Inc.	PLAINS
Pennwalt Corp.	PMSCO
Liquid Carbonic Specialty Gas	PO
Pocahontas Welding Supply Co.	POCA
Liquid Carbonic Specialty Gas	POCO
Union Carbide Linde Division	POL
Airco Gases	POXCO
Airco Gases	POXSAL
Propane Power Corporation	PPC
Phoenix Research Corporation	PRC
AGA Gas, Inc.	PREC GAS
Cutting Fuels, Inc.	PRESLEN
The Price-Bass Co., Inc.	PRICE-B
Liquid Carbonic Inc.	PROVINCIAL GAS LTD
Pennwalt Corporation	PSMCO
Pressed Steel Tank Co., Inc.	PST
C. W. Pulver, Inc.	PULVERS GAS SERVICE
Purdue University	PURDUE
Airco Gases	PURECO

Airco Gases	PWS
MG Industries	PWS
OXARC, Inc.	PYCO
Liquid Carbonic Specialty Gas	P&GCO
Racon Inc.	RACON
Raimy Corporation	RAIMY
Dakota Welding Supply Co., Inc.	RD
Red Ball Oxygen Co., Inc.	REBOCO
Reynolds Welding Supply Co.	REYWEL
Southern Welding Supply, Inc.	RFD/JKD
Southern Welding Supply, Inc.	RFD/KMD
Big Three Industries, Inc.	RGVOC
Franke Filling, Inc.	RIPINC
Rockford Ind. Welding Supply	RIS
Rite Weld Supply, Inc.	RITEWEL
R.I. Welding Supply Co., Inc.	RIWS CO
Airco Gases	RIWSCO
Welding Engineering & Supply Co.	RJP/EWS
Barton's Welding Supply	RLC
Jones Welders Supply	RLJ
Roberts Oxygen Company, Inc.	ROB-OX
Thornton Enterprises	RVT
Richard Welding Equipment, Inc.	RWE
R & R Welding Supply Co.	R&R WSCO
Acetylene Gas Company	R.E.D.D.OX
Virginia Welding Supply Company, Inc.	R.V. MAY COMPANY
Gas Systems, Inc.	SAFGAS
Liquid Carbonic Specialty Gas	SAGCOLTD
Big Three Industries, Inc.	SANOCO
Big Three Industries, Inc.	SAOCO
Spoon Automotive Parts, Inc.	SAPA
Paul Carroll Welding Supply, Inc.	SAX
Suburban Welders Supply Co., Inc.	SBWS
Steel Cylinder Mfrg. Ltd.	SCM
Scott - Gross Co., Inc.	SCOTT-G
Scully Welding Supply Corp.	SCULLY
San Diego Welders Supply, Inc.	SDWESCO
San Diego Welders Supply, Inc.	SDWSCO
Cryo Dyne Corp.	SEABERG

Airco Gases	SELOX
Schultz Gas Service, Inc.	SGHG
Air Products & Chemcials, Inc.	SGI
Scott Specialty Gas	SGP
Shaw Oxygen Co., Inc.	SHAW
AGA Gas, Inc.	SHURMAX
Liquid Carbonic Specialty Gas	SIG
Sims Welding Supply Co., Inc.	SIMSCO
MG Industries	SIPP
Selox, Inc.	SLX
Liquid Carbonic Specialty Gas	SMG
Scott-Marrin, Inc.	SMI
Liquid Carbonic Specialty Gas	SMO
Liquid Carbonic Specialty Gas	SNCCO
Air Products & Chemicals, Inc.	SOB
Phoenix Welding Supply	SOCAL
Air Products & Chemicals, Inc.	SOCO
Airco Gases	SOCO
Liquid Carbonic Specialty Gas	SOCO
MG Industries	SOCO
Sooner Supplies, Inc.	SOONER
SOS Gases Inc.	SOS
Southern Welding Supply Co.	SOWCO
Rice Welding Supply Co., Inc.	SPEEDS
Suburban Propane Gas, Inc.	SPG
Welders Sup. Co. of Louisville	SPGASLOU
National Welders Supply Company, Inc.	SPWSCO
Scott Specialty Gas	SRL
Willard C. Starcher, Inc.	STARCHER
Airco Gases	STOCO
Strate Welding Supply Co., Inc.	STRATE
MG Industries	ST. LOUIS
Sunox, Inc.	SUNOX
Sunset Wire Rope Company	SUNSET WIRE ROPE
Superior Welding Supply Co.	SUPWELD
Superior Welding Supply	SUPWS
Liquid Carbonic Inc.	SWS
Airco Gases	SWSCO
Southern Welding Supply Inc.	SWSRP

Sawtelle & Rosprim Hardware, Inc.	S&R
Liquid Carbonic Specialty Gas	TAE
Tanx Co.	TANX
AGA Gas, Inc.	TECHGAS
Terry Supply Company	TERRY
Terrace Supply Company	TESC
TEWECO, Inc.	TEWECO
Airco Gases	TEXCWEL
Texas Oxygen, Inc.	TEXOX
Bob Smith Corp.	TGT-LUF
Thomas Gas Service, Inc.	THOMAS
National Welders Supply Co., Inc.	THOMPSON W.S.
MG Industries	THOS EDI
Texas Industrial Gas, Inc.	TIG
Timco Welding Supply	TIMCO
Big Three Industries, Inc.	TOC
Toledo Oxygen & Equipment Company	TOEC
Tampa Oxygen & Welding Supply, Inc.	TOWS
MG Industries	TRICON
Trinity Industries, Inc.	TRINITY
Trinity Industries, Inc.	TSIF
Big Three Industries, Inc.	TVWS
Taylor-Wharton, Div. of HARSCO	TW - in a circle.
West Welding Supply	TWSST
Urie and Blanton	UBCO
Union Carbide Linde Division	UCIA
Union Carbide Linde Division	UCON
Utility Propane Company	UPPCO
U. S. Department of Justice	USNEP
United States Welding Inc.	USWW
Utah Tech. College at Salt Lake	UTC/SL
United Welding Supply Co. Inc.	UTWNY
Airco Gases	VAOCO
Virginia Welding Supply Company, Inc.	VAWELD
Virginia Welding Supply Co.	VAWELD
V&G Welding Supply Inc.	VGW
Airco Gases	VICTORCO
Volunteer Welding Supply, Inc.	VOLWS
Liquid Carbonic Specialty Gas	VOXCO

Valley Welding Supply Co., Inc.	VWS
Valley Welders Supply Company	VWSC
Valley Welding Supply Co.	VWS-CO
V&G Welding Supply Inc.	V&G
Airco Gases	WA
Airco Gases	WAI
MG Industries	WALL
Airco Gases	WAP
Liquid Carbonic Specialty Gas	WAPCO
Airco Gases	WAPI
Airco Gases	WAPINC
Airco Gases	WAPINE
Welding & Supply Co., Inc.	WASCO
Waukegan Welding Supply Co. Inc.	WAUK
Waco Welder's Supply Co., Inc.	WAWESCO
Wayne Oxygen Company, Inc.	WAYNE
Wright Brothers, Inc.	WBI
National Ammonia Co.	WBS
Union Carbide Linde Division	WCCO
Liquid Carbonic Specialty Gas	WCI
Weber Welding Supply Company	WEBCO
Weber Welding Supply Company	WEBWELD
Airco Gases	WELCO
Weldco, Inc.	WELDCO
General Welding Supply Co.	WELDING EQUIPMENT CO.
Welding Products of Texas, Inc.	WELDPRO
Welders Supply Co.-Beloit, Inc.	WELDSUP
AGA Gas, Inc.	WELKER
Welders Sup. Co. of Louisville	WELOFLOU
Welder's Products & Service, Inc.	WELPDSER
Welsco, Inc.	WELSCO
Welders Supply Company	WELSP
Welders Supply	WELSUP
Wesco Redwood, Inc.	WESCO OF CAL
Welding Engineering Supply Co.	WESCO-P
West Penn Laco, Inc.	WESPEN
Western Welding Supply Co., Inc.	WESTWS
U.S. Welders Supply Co., Inc.	WESU
Welsco, Inc.	WESUCO

Welders Equipment Company	WEVCCT
Whitey Company	WHITEY
Air Products & Chemicals, Inc.	WIG
Willett Bros., Inc.	WILLETT
Wilson Oxygen & Supply Co., Inc.	WILOX
Big Three Industries, Inc.	WIP
Welders Industrial Supply Co., Inc.	WISCO
Liquid Carbonic Specialty Gas	WMI
Liquid Carbonic Specialty Gas	WNOCO
Liquid Carbonic Specialty Gas	WOC
Whitmore Oxygen Company	WOCO
Airco Gases	WORTHWELD
Union Carbide Linde Division	WO&GPCo
Wayne Oxy. & Welding Sup. Co.	WO&WS
Weldco, Inc.	WPB
Welding Products of Georgia Inc.	WPGI
Welding Prod. of Kentucky, Inc.	WPKY
Welders Supply, Inc.	WSEP
Welding Supply House, Inc.	WSHSE
Welders Supply, Inc.	WSI
Air Products & Chemicals, Inc.	WSIPC
Welders Supply, Inc.	WSIPC
Welders Supply, Inc.	WSJ
Airco Gases	WSPHPA
Mathews Chemical & Supply Co., Inc.	WS&E CO
Welding & Therapy Service, Inc.	WTSI
West Texas Welders Supply, Inc.	WTWS
Weiler Welding Co., Inc.	WWCO
Wesco Redwood Inc.	WWS CAL
AGA Gas, Inc.	WWSCO
Wagner Welding Supply Co.	WWSLC
West Welding Supply	WWSST
Western Washington Welding, Inc.	WWWD
Airco Gases	W&I
MG Industries	W&S
Weldinghouse, Inc.	W-Under Roof/Underlined in a circle.
Liquid Carbonic Specialty Gas	W.I. CO
Union Carbide Linde Division	XLAPCO
Union Carbide Linde Division	XLINDE

Union Carbide Linde Division	XPOL
Union Carbide Linde Division	X_P
Acetylene Gas Company	Z.W.
Mississippi Welders Sup. Co., Inc.	"BLANCHE"
Virginia Welding Supply Company, Inc.	"MAY COMPANY"
Virginia Welding Supply Company, Inc.	"OXYGEN OF KENTUCKY"
Marse Welding Supplies, Inc.	(MWS) MARSE INC.
Bock Bros. Welding Supply Co.	*BOCK
Union Carbide Linde Division	_P

CYLINDER SYMBOLS REGISTERED WITH THE COMPRESSED GAS ASSOCIATION, INC.

SORTED BY COMPANY

A & A Welder's Supply, Inc.	A.A.W.S.I.
ABSCO Distributing	ABSCO
Acetylene Gas Company	AG - G in the lower half of the "A".
Acetylene Gas Company	A.G.C.
Acetylene Gas Company	CHASECO
Acetylene Gas Company	I.A.P.
Acetylene Gas Company	I.S.
Acetylene Gas Company	I.W.
Acetylene Gas Company	K.A.P.
Acetylene Gas Company	M.A.P.
Acetylene Gas Company	M.G.MS
Acetylene Gas Company	R.E.D.D.OX
Acetylene Gas Company	Z.W.
Acetylene Products Co., Inc.	APC
Adirondack Bottled Gas Corp.	ABGC
AETNA Gas Products, Inc.	AETNAGAS
AGA Gas, Inc.	AGA
AGA Gas, Inc.	AGA USA
AGA Gas, Inc.	AGAGAS
AGA Gas, Inc.	AGAS
AGA Gas, Inc.	AREA CO
AGA Gas, Inc.	AWL
AGA Gas, Inc.	BOCO
AGA Gas, Inc.	BURCO
AGA Gas, Inc.	BURDOX
AGA Gas, Inc.	BX
AGA Gas, Inc.	BYRD
AGA Gas, Inc.	EASTEP
AGA Gas, Inc.	KANWELD
AGA Gas, Inc.	OSAIR
AGA Gas, Inc.	TECHGAS
AGA Gas, Inc.	WELKER
AGA Gas, Inc.	WWSCO
AGA Gas, Inc.	GATEOX

AGA Gas, Inc.	GLENDOX
AGA Gas, Inc.	G&MC
AGA Gas, Inc.	JW&SCO
AGA Gas, Inc.	KELSEY
AGA Gas, Inc.	KKK
AGA Gas, Inc.	OBWSCO
AGA Gas, Inc.	PREC GAS
AGA Gas, Inc.	SHURMAX
AIFA Products/Morton Thiokol, Inc.	AIFA PRODUCTS
Air Products & Chemcials, Inc.	SGI
Air Products & Chemicals, Inc.	AGCD
Air Products & Chemicals, Inc.	AIRWELD
Air Products & Chemicals, Inc.	ALDAN
Air Products & Chemicals, Inc.	APROINC
Air Products & Chemicals, Inc.	ATSCO
Air Products & Chemicals, Inc.	AWSCSC
Air Products & Chemicals, Inc.	AWSSAT
Air Products & Chemicals, Inc.	BALBACH
Air Products & Chemicals, Inc.	BARNUM
Air Products & Chemicals, Inc.	BCO
Air Products & Chemicals, Inc.	BISWLDG
Air Products & Chemicals, Inc.	CEB
Air Products & Chemicals, Inc.	CHWES
Air Products & Chemicals, Inc.	DELTA
Air Products & Chemicals, Inc.	DENTON
Air Products & Chemicals, Inc.	EWSCINC
Air Products & Chemicals, Inc.	GARCRY
Air Products & Chemicals, Inc.	HILLESCO
Air Products & Chemicals, Inc.	IND SPEC
Air Products & Chemicals, Inc.	JACS
Air Products & Chemicals, Inc.	KWSCO
Air Products & Chemicals, Inc.	LAVIS
Air Products & Chemicals, Inc.	MHOC
Air Products & Chemicals, Inc.	OREWS
Air Products & Chemicals, Inc.	SOB
Air Products & Chemicals, Inc.	SOCO
Air Products & Chemicals, Inc.	WIG
Air Products & Chemicals, Inc.	WSIPC
Airco Gases	ACME

Airco Gases	ACMEGAS
Airco Gases	AEM
Airco Gases	AEMM
Airco Gases	AMGAS
Airco Gases	AMGS
Airco Gases	AMWSCO
Airco Gases	AOXCO
Airco Gases	ARCO
Airco Gases	ARCOM
Airco Gases	AUSCO
Airco Gases	BALAAM
Airco Gases	BELCON
Airco Gases	BERRY
Airco Gases	BOND
Airco Gases	BONDS
Airco Gases	BOWS
Airco Gases	BUDS
Airco Gases	BWWSCO
Airco Gases	CALGAS
Airco Gases	CALOX
Airco Gases	CALOXLA
Airco Gases	CENTRAL
Airco Gases	CGCO
Airco Gases	CWSCI
Airco Gases	CWSCO
Airco Gases	DELTA
Airco Gases	DO&SCO
Airco Gases	DUVAL
Airco Gases	DWECO
Airco Gases	FBWS
Airco Gases	GWECO
Airco Gases	HARCO
Airco Gases	HAV-PON
Airco Gases	IRVWELD
Airco Gases	JWSC
Airco Gases	LOCO
Airco Gases	LRWS
Airco Gases	MAGNOLIA
Airco Gases	MGPCO

Airco Gases	MINEWELD
Airco Gases	M-WELD
Airco Gases	OC&MCO
Airco Gases	OC&SEC
Airco Gases	OMP
Airco Gases	OSSCO
Airco Gases	PCCA
Airco Gases	POXCO
Airco Gases	POXSAL
Airco Gases	PURECO
Airco Gases	PWS
Airco Gases	RIWSCO
Airco Gases	SELOX
Airco Gases	SOCO
Airco Gases	STOCO
Airco Gases	SWSCO
Airco Gases	TEXCWEL
Airco Gases	VAOCO
Airco Gases	VICTORCO
Airco Gases	WA
Airco Gases	WAI
Airco Gases	WAP
Airco Gases	WAPI
Airco Gases	WAPINC
Airco Gases	WAPINE
Airco Gases	WELCO
Airco Gases	WORTHWELD
Airco Gases	WSPHPA
Airco Gases	W&I
Akron Oxygen and Supply Co., Inc.	AKROX
All Pure Chemical Co., Inc.	ALLP
Allied Corp. Engd. Mat'ls. Sector	ACC-SCD
Allied Corp. Engd. Mat'ls. Sector	ALL-SIG
Allied-Signal Inc.	ACC-SCD
Amarillo Coca-Cola Bottling Co.	ACCBC
Amerex Corporation	AX
American Compressed Gases, Inc.	A - In a badge shape.
American Compressed Gases, Inc.	ACG
American Industrial Gases, Inc.	AIGI

American Oxygen Company, Inc.	AMERCO
American Welding Supply	AWS-SJ
Andrus Equipment Corp.	ANDRUS
Andrus Equipment Corp.	JUSTICE
Ansul Tank Manfacturing	ATM
Approved Fire Protection Co.	AFPCO
Arco Welding Supply Co., Inc.	ARCOWS
Arizona Welding Equipment Co.	AWECO
Arizona Welding Equipment Co.	AZ WELDING
Arkansas Specialty Co., Inc.	MRS-MEA
Arthur's Sales & Service, Inc.	ASSKA
Ashland Chemical Company	ASHCCO
Athens Welding Supply	ATHENSWS
AWISCO, Inc.	AWSC, INC
A. G. Pond Co.	HAV-PON
Badger Welding Supplies, Inc.	BWSUP
Bail Welding Supplies	BWS
Barclay Company	BARCO
Barton Welding Supply	BOWS
Barton's Welding Supply	E&K
Barton's Welding Supply	RLC
Bennett Welding Supply Corporation	BENNETT
Big Three Industries, Inc.	BAO
Big Three Industries, Inc.	BTWECO
Big Three Industries, Inc.	BTWSCO
Big Three Industries, Inc.	CCOCO
Big Three Industries, Inc.	CHEM (Use in Hawaii Only)
Big Three Industries, Inc.	HOCO
Big Three Industries, Inc.	IOSCO
Big Three Industries, Inc.	NCG (Use in Hawaii Only)
Big Three Industries, Inc.	OXCO
Big Three Industries, Inc.	RGVOC
Big Three Industries, Inc.	SANOCO
Big Three Industries, Inc.	SAOCO
Big Three Industries, Inc.	TOC
Big Three Industries, Inc.	TVWS
Big Three Industries, Inc.	WIP
Big Three Lincoln Alaska Inc.	AWSCORP
Big Three Lincoln Alaska Inc.	BTLA

Bird Space Technology	BIRD
Blackhawk Gases & Supply Co.	DJB
Bob Smith Corp.	BOSMCO
Bob Smith Corp.	TGT-LUF
Bock Bros. Welding Supply Co.	*BOCK
Bower Ammonia & Chemical Co.	BOWER
Brand Dry Ice Inc.	BDI
Brooks Welding Supply Company	BRWELCO
Brown Welding Supply, Inc.	BWSINC
Buckeye Corporation	BUCK
Buckeye Welder Services, Inc.	BUCK-WELD
Buffalo Welding Supply Co., Inc.	BUWS
Butler Gas Products Co.	BUTGAS
BWS, Inc.	Bakersfield Welding Supply
B. Barer & Sons, Inc.	BARER
Caldwell Welding Supply Company	CALDWYN
California Welding Supply Co.	BAY
Cameron Welding Supply	CAMERON
Canadian Cylinder Co. Ltd.	CDNCYL
Canadian Liquid Air Ltd.	ALS
Capital Welding Sup. Co. Inc.	CS - Capital Supply
Capitol Corporation	CAPITOL
Capitol Oxygen Company Limited	CAPOXY
Cascade Airgas Inc.	CAI
Cee Kay Supply, Inc.	CEE-KAY
Central Welding Supplies, Inc.	CEWESU
Cen-Tex Gas, Inc.	CENTEX
Clovis Equipment & Supply Company.	CESCONM
Coast Welding Supply	CWSH
Compositek Engineering Corporation	COMTEK
Continental Chemical Company	CON-O
Conwin Carbonic Co.	CONWIN
Cook's Gas Inc.	COOKGAS
Corp Brothers, Inc.	CORP
Coss Welding Supply, Inc.	COSS
Coyne Cylinder Company	C with diamond
Coyne Cylinder Company	COYCO
Coyne Cylinder Company	COYNE
Crumpton Welding Sup. & Equip. Inc.	CWSTF

Cryo Dyne Corp.	SEABERG
Cutting Fuels, Inc.	PRESLEN
C. W. Pulver, Inc.	CWPULVER
C. W. Pulver, Inc.	C.W.P.
C. W. Pulver, Inc.	PULVERS GAS SERVICE
Dakota Welding Supply Co., Inc.	RD
Dalox Welding Supply Co.	DALOX
David Soda Dispensing Co.	DSDCO
Dempsey Enterprises	CDGS
Dempsey Enterprises	CWP
Dempsey Enterprises	MFG
Dempsey Enterprises	MPDSR
Denton Welding Supply	DENTON
Depke Welding Supplies, Inc.	DEPKE
Detroit Gas Products Co.	DGP
Dixie Oxygen Co., Inc.	D-OX
Doansco Welding Supply	DOANSCO
Eagle Air Systems	EAGLE AIR SYSTEMS
Earl's Welders Supply Company	ELMWS
East Texas Oxygen Company	ETOX
East Texas Oxygen Company	ETOX
Ekohwerks Company	EKO
Etex, Inc.	ETEXING
Etox, Inc.	ETOXINC
Eureka Oxygen Co.	EUROX
Evans Welding Supply Co., Inc.	EWESCO
Exodus, Ltd.	CLIG
E.I. du Pont de Nemours & Co.	DUCON
E.I. du Pont de Nemours & Co.	DUPP
E.I. du Pont de Nemours & Co.	KCINC
Farmers Elevator Co.	FEC
Findley Welding Supply, Inc.	FWSINC
Franke Filling, Inc.	RIPINC
Fred E. Barnett Co.	FEBCO
G & E Welding Supply Co. Inc.	GESUP
Gas Systems, Inc.	GSI
Gas Systems, Inc.	SAFGAS
General Air Service & Supply Co.	GASES
General Cryogenics Corporation	GWCO

General Gases & Supplies Corp.	B443
General Gases & Supplies Corp.	GENERGAS
General Welding Supply Co.	ADAM
General Welding Supply Co.	CCG CRYCO
General Welding Supply Co.	CIGE CORP
General Welding Supply Co.	DOUTHOX
General Welding Supply Co.	GENWEL
General Welding Supply Co.	GENWES
General Welding Supply Co.	GOCO
General Welding Supply Co.	GOCO
General Welding Supply Co.	G.W.S.
General Welding Supply Co.	NORWESCO
General Welding Supply Co.	WELDING EQUIPMENT CO.
Gerin Welding Sales, Inc.	GERIN
Gerin Welding Sales, Inc.	GERINSC
Greco Welding Supplies, Inc.	GRECO
G. P. Modlish, Inc.	GPM
Hammack Welding Supply, Inc.	HAMMACK
Harris Calorific Sales, Inc.	HCS
Haun Welding Supply Inc.	HAUN
Herring Welding Supply, Inc.	HERRING
Hinely Air Products, Inc.	HINELY
Hiram Rivera	CENTRO
Hobart North Welding Supply, Inc.	HOBART-N
Holston Gases, Inc.	HOXCO
Hoprich Co. Inc.	HR
Houston Lighting & Power Co.	HL&PCO
Huber Supply Co., Inc.	HUBCO
Hust Bros. Inc.	HUST
ICG Liquid Gas Ltd.	ICG CORP.
ICI Americas Inc.	ICI-BCF
IGO'S Welding Supply Co., Inc.	IGO
Industrial Gas & Supply Co.	IGSCO
Industrial Gas & Supply Co.	KWELSUP
Industrial Gas & Supply Co.	OXSCO
Industrial Oxygen Co., Inc.	INOXCO
Industrial Safety Equip Co., Inc.	ISECO
Industrial Sales & Leasing	IOSCO
Industrial Welding Supplies Inc.	INDSI

Industrial Welding Supply, Inc.	IWSCO
Industrial Welding Supply Inc.	IWSI
Interstate Ind. of New Jersey	I.I.I.
Interstate Welding Sales Corp.	INTERSTATE
Inweld Corporation	CARDINAL
Inweld Corporation	INWELD
Inweld Corp.	INWELD
Island Equipment Co.	IECO (ISLAND)
J A Welding Supply Co., Inc.	JAWS
Jack B. Kelley Company	Orange w/silver strip/JBK Co.around neck
Jackson Welding Supply Co., Inc.	JAWESCO
Jackson Welding Supply Co. Inc.	JACKWELS
James Oxygen & Supply Co.	JO2
James Oxygen & Supply Co.	JOS
Jones Chemicals, Inc.	BNH
Jones Welders Supply	RLJ
Keen Compressed Gas Co., Inc.	KEENFLAME
Keen Welding Supplies, Inc.	KEENCO
Keystone Metal Welding Supply, Inc.	KMWS
Kirk Welding Supply	KWCO
Kirk Welding Supply	K-I-CO
Langdon Oxygen Company	LANGCO
LaRoche Industries Inc.	ARMOUR AMMONIA DIVISION
LaRoche Industries Inc.,	A & CO
LaRoche Industries Inc.,	ARMOUR AMMONIA WORKS
LaRoche Industries Inc.,	LII
Layman Welding Supply Co.	LAYMAN
Lincoln Big Three, Inc.	L-B-3
Linde Gas of the West	IS&R
Liquid Air Corporation	M-FC
Liquid Carbonic Inc.	AGS
Liquid Carbonic Inc.	BAKERSFIELD WELDING SUPPLY
Liquid Carbonic Inc.	CANADIAN ANAESTHETIC GASES LTD
Liquid Carbonic Inc.	CROWN CARBONIC LTD
Liquid Carbonic Inc.	CWSI
Liquid Carbonic Inc.	CYL. GAS
Liquid Carbonic Inc.	DTL
Liquid Carbonic Inc.	GAS DYNAMICS (CANADA) LTD
Liquid Carbonic Inc.	IMPOX

Liquid Carbonic Inc.	INDUSTRIAL GASES & SUPPLIES LTD
Liquid Carbonic Inc.	LCCL
Liquid Carbonic Inc.	LCI
Liquid Carbonic Inc.	NATOX
Liquid Carbonic Inc.	OGC
Liquid Carbonic Inc.	OXY-WELD LTD.
Liquid Carbonic Inc.	PINTSCH COMPRESSING CORPORATION
Liquid Carbonic Inc.	PROVINCIAL GAS LTD
Liquid Carbonic Inc.	SWS
Liquid Carbonic Specialty Gas	ABC
Liquid Carbonic Specialty Gas	ACCORP
Liquid Carbonic Specialty Gas	ACME OX
Liquid Carbonic Specialty Gas	AGS
Liquid Carbonic Specialty Gas	AIGI
Liquid Carbonic Specialty Gas	ALL STATE
Liquid Carbonic Specialty Gas	AOS
Liquid Carbonic Specialty Gas	AO&AC
Liquid Carbonic Specialty Gas	APEX
Liquid Carbonic Specialty Gas	ARCO
Liquid Carbonic Specialty Gas	ARROWELD
Liquid Carbonic Specialty Gas	BCCO
Liquid Carbonic Specialty Gas	BGC
Liquid Carbonic Specialty Gas	BLAUGAS
Liquid Carbonic Specialty Gas	BOCO
Liquid Carbonic Specialty Gas	BOXCO
Liquid Carbonic Specialty Gas	B&BCO
Liquid Carbonic Specialty Gas	CARBO OXYGEN
Liquid Carbonic Specialty Gas	CCBO
Liquid Carbonic Specialty Gas	CCCO
Liquid Carbonic Specialty Gas	CCLTD
Liquid Carbonic Specialty Gas	CENCO
Liquid Carbonic Specialty Gas	CGC
Liquid Carbonic Specialty Gas	CHENEY
Liquid Carbonic Specialty Gas	COCO
Liquid Carbonic Specialty Gas	COGASCO
Liquid Carbonic Specialty Gas	COLOX
Liquid Carbonic Specialty Gas	CONNOX
Liquid Carbonic Specialty Gas	COXCO
Liquid Carbonic Specialty Gas	CRCINC

Liquid Carbonic Specialty Gas	CRCO
Liquid Carbonic Specialty Gas	DCCLTD
Liquid Carbonic Specialty Gas	DHS
Liquid Carbonic Specialty Gas	DJJCO
Liquid Carbonic Specialty Gas	EAPCO
Liquid Carbonic Specialty Gas	EMO
Liquid Carbonic Specialty Gas	FFCCO
Liquid Carbonic Specialty Gas	FG & CC
Liquid Carbonic Specialty Gas	GCCO
Liquid Carbonic Specialty Gas	GIG
Liquid Carbonic Specialty Gas	IOCO
Liquid Carbonic Specialty Gas	JBCO
Liquid Carbonic Specialty Gas	JEJR
Liquid Carbonic Specialty Gas	KCCO
Liquid Carbonic Specialty Gas	KCG
Liquid Carbonic Specialty Gas	KICO
Liquid Carbonic Specialty Gas	KOCO
Liquid Carbonic Specialty Gas	LCCO
Liquid Carbonic Specialty Gas	LCPORP
Liquid Carbonic Specialty Gas	LEWS
Liquid Carbonic Specialty Gas	LIVOXCO
Liquid Carbonic Specialty Gas	NEGP
Liquid Carbonic Specialty Gas	NEWCO
Liquid Carbonic Specialty Gas	NVOC
Liquid Carbonic Specialty Gas	OGC
Liquid Carbonic Specialty Gas	PACIFIC
Liquid Carbonic Specialty Gas	PO
Liquid Carbonic Specialty Gas	POCO
Liquid Carbonic Specialty Gas	P&GCO
Liquid Carbonic Specialty Gas	SAGCOLTD
Liquid Carbonic Specialty Gas	SIG
Liquid Carbonic Specialty Gas	SMG
Liquid Carbonic Specialty Gas	SMO
Liquid Carbonic Specialty Gas	SNCCO
Liquid Carbonic Specialty Gas	SOCO
Liquid Carbonic Specialty Gas	TAE
Liquid Carbonic Specialty Gas	VOXCO
Liquid Carbonic Specialty Gas	WAPCO
Liquid Carbonic Specialty Gas	WCI

Liquid Carbonic Specialty Gas	WMI
Liquid Carbonic Specialty Gas	WNOCO
Liquid Carbonic Specialty Gas	WOC
Liquid Carbonic Specialty Gas	W.I. CO
Liquid Gas Co.	LIGACO
Logan Hagan Welding Supply, Inc.	LHWS
L. Miller & Son, Inc.	LM&S
L. V. Paul & Sons Equipment Corp.	PAULCO
Machine & Welding Supply Company	MACHCO
Magna-Fab Industries Inc.	MFL
Mansfield Oxygen Corporation	MOA
Mansfield Oxygen Corporation	MOAS
Marse Welding Supplies, Inc.	(MWS) MARSE INC.
Matheson Gas Products	MC
Mathews Chemical & Supply Co., Inc.	WS&E CO
McMillan Supply Company	HFM
Metalweld, Inc.	BOWLING
Metrolina Welding Inc.	MWI
MG Industries	AWISCO
MG Industries	BOSMET
MG Industries	BUCO
MG Industries	CHEM
MG Industries	IRW
MG Industries	JWS SHUTTE
MG Industries	KAPCO
MG Industries	KC
MG Industries	KEYCG
MG Industries	MGB
MG Industries	MGI
MG Industries	MGIND
MG Industries	MGSG
MG Industries	MGTP
MG Industries	NCG
MG Industries	PWS
MG Industries	SIPP
MG Industries	SOCO
MG Industries	ST. LOUIS
MG Industries	THOS EDI
MG Industries	TRICON

MG Industries	WALL
MG Industries	W&S
Miami Industrial Gases, Inc.	MIGINC
Michiana Welding Supply, Inc.	MISB
Midwest Bottle Gas Co.	MIDWEST
Midwest Welding Supply, Inc.	AWC
Midwest Welding Supply, Inc.	MWSC
Midwest Welding Supply, Inc.	MWS-CHI
Mid-State Welding Supply, Inc.	MID-STATE WS
Mississippi Welders Sup. Co., Inc.	"BLANCHE"
Mississippi Welding Supply, Inc.	MWI
Missouri Oxygen Co.	MO-OX
Modern Gas Co., Inc.	MOGCO
Modern Gas Service Corporation	MML
Monarch Chemicals, Inc.	MOCH
Monroe Welding Supply, Inc.	MWSCO
Moore Bros.	MOORE BROS.
Moore Bros.	MOORES
Moore's Welding Supply Co.	MOORE
Nanco Inc.	KATIM
Nanco Inc.	NANCO
National Ammonia Co.	NACO
National Ammonia Co.	WBS
National Dry Ice	LDA
National Welders Supply Company, Inc.	OOWSCO
National Welders Supply Company, Inc.	SPWSCO
National Welders Supply Co., Inc.	BRAWEL
National Welders Supply Co., Inc.	CHESCO
National Welders Supply Co., Inc.	MOLONY
National Welders Supply Co., Inc.	NWSCO
National Welders Supply Co., Inc.	NWSCO-SG
National Welders Supply Co., Inc.	THOMPSON W.S.
National Welding Supply, Inc.	NAWESCO
National Welding Supply Co. (Inc.)	NWS-FTW
New Bedford Welding Supply, Inc.	NBWS INC.
New Hampshire Welding Sup. Corp.	NHWSCO
Newton Welding Supply, Inc.	NEWWELD
Nordan Smith Welding Supplies	NSWELD
Nordan's Welding & Safety Supply	NORDAN'S

Northeast Airgas, Inc.	GRAVES
Northeast Airgas, Inc.	GSOXY
Northeast Airgas, Inc.	NHWSCO
Northeastern Ammonia Co.	NORAMCO
Northern Welding & Supply	NORWELD
Northern Welding & Supply Co.	NORWELD
N. Collins Cylinder Gas Co., Inc.	NOR-COL
OXARC, Inc.	OXARC
OXARC, Inc.	PYCO
Oxygen Sales & Service, Inc.	IGS
Oxygen Sales & Service, Inc.	IND GAS SUPPLY
Oxygen Sales & Service, Inc.	OSSCO TACOMA WA
Oxygen Sales & Service, Inc.	OSSINC
Oxygen Service Company	JAYOX
Oxygen & Welding Supply Co., Inc.	A928
Ozark Fire Entinguisher, Inc.	OZARK
O. E. Meyer Co.	A819
Parrish Welding Supply, Inc.	PARRISH
Patsems, Inc.	PJA
Paul Carroll Welding Supply, Inc.	CWS
Paul Carroll Welding Supply, Inc.	SAX
Pennsylvania Engineering Company	PEN
Pennwalt Corporation	PSMCO
Pennwalt Corp.	PMSCO
People Greeters	BPG
Phoenix Research Corporation	PRC
Phoenix Welding Supply	SOCAL
Plains Welding Supply, Inc.	PLAINS
Pocahontas Welding Supply Co.	POCA
Potomac Airgas	AS&SCO
Potomac Airgas	BWI
Potomac Airgas	FW&S
Potomac Airgas	LAP
Potomac Airgas	PBM
Pressed Steel Tank Co., Inc.	PST
Propane Power Corporation	PPC
Purdue University	PURDUE
Puritan-Bennett Corporation	PCGCO
P. G. Walker & Son, Inc.	PGW - PWG in a diamond.

R & R Welding Supply Co.	R&R WSCO
Racon Inc.	RACON
Raimy Corporation	RAIMY
Red Ball Oxygen Co., Inc.	REBOCO
Reynolds Welding Supply Co.	REYWEL
Rice Welding Supply Co., Inc.	SPEEDS
Richard Welding Equipment, Inc.	RWE
Riggs Welders Supplies, Inc.	HARCO
Riggs Welders Supplies, Inc.	LRWSI
Rite Weld Supply, Inc.	RITEWEL
Roberts Oxygen Company, Inc.	ROB-OX
Rockford Ind. Welding Supply	RIS
R.I. Welding Supply Co., Inc.	RIWS CO
San Diego Welders Supply, Inc.	SDWESCO
San Diego Welders Supply, Inc.	SDWSCO
Sawtelle & Rosprim Hardware, Inc.	S&R
Schultz Gas Service, Inc.	SGHG
Scott Specialty Gas	SGP
Scott Specialty Gas	SRL
Scott - Gross Co., Inc.	SCOTT-G
Scott-Marrin, Inc.	SMI
Scully Welding Supply Corp.	SCULLY
Selox, Inc.	SLX
Shaw Oxygen Co., Inc.	SHAW
Sims Welding Supply Co., Inc.	SIMSCO
Soda System	NSFCO
Sooner Supplies, Inc.	SOONER
SOS Gases Inc.	SOS
Southern Welding Supply, Inc.	RFD/JKD
Southern Welding Supply, Inc.	RFD/KMD
Southern Welding Supply Co.	SOWCO
Southern Welding Supply Inc.	SWSRP
Spoon Automotive Parts, Inc.	SAPA
Steel Cylinder Mfrg. Ltd.	SCM
Strate Welding Supply Co., Inc.	STRATE
Suburban Propane Gas, Inc.	SPG
Suburban Welders Supply Co., Inc.	SBWS
Sunox, Inc.	IWSINC
Sunox, Inc.	PIEDWS

Sunox, Inc.	SUNOX
Sunset Wire Rope Company	SUNSET WIRE ROPE
Superior Welding Supply	SUPWS
Superior Welding Supply Co.	SUPWELD
Tampa Oxygen & Welding Supply, Inc.	TOWS
Tanx Co.	TANX
Taylor-Wharton, Div. of HARSCO	H - in a circle.
Taylor-Wharton, Div. of HARSCO	TW - in a circle.
Terrace Supply Company	TESC
Terry Supply Company	TERRY
TEWECO, Inc.	TEWECO
Texas Industrial Gas, Inc.	TIG
Texas Oxygen, Inc.	TEXOX
The Ansul Company	ANSUL
The Home Gas Corporation	HOMGAS
The Price-Bass Co., Inc.	PRICE-B
Thomas Gas Service, Inc.	THOMAS
Thornton Enterprises	RVT
Timco Welding Supply	TIMCO
Toledo Oxygen & Equipment Company	TOEC
Town & Country Gas Service Inc.	LEVCO
Trinity Industries, Inc.	TRINITY
Trinity Industries, Inc.	TSIF
Union Carbide Canada Ltd.	C LINDE
Union Carbide Canada Ltd.	CDOCO
Union Carbide Canada Ltd.	CLAPCO
Union Carbide Canada Ltd.	CPOL
Union Carbide Canada Ltd.	CXLAPCO
Union Carbide Canada Ltd.	CXPOL
Union Carbide Canada Ltd.	LINDE - with Oak Leaf
Union Carbide Linde Division	CGC
Union Carbide Linde Division	C&CCCo
Union Carbide Linde Division	GSC
Union Carbide Linde Division	IAC
Union Carbide Linde Division	ICCO
Union Carbide Linde Division	IOC
Union Carbide Linde Division	IOCO
Union Carbide Linde Division	LAPCO
Union Carbide Linde Division	LINDE with Oak Leaf

Union Carbide Linde Division	POL
Union Carbide Linde Division	UCIA
Union Carbide Linde Division	UCON
Union Carbide Linde Division	WCCO
Union Carbide Linde Division	WO&GPCo
Union Carbide Linde Division	XLAPCO
Union Carbide Linde Division	XLINDE
Union Carbide Linde Division	XPOL
Union Carbide Linde Division	X_P
Union Carbide Linde Division	_P
United States Welding Inc.	USWW
United Welding Supply Co. Inc.	UTWNY
Urie and Blanton	UBCO
Utah Tech. College at Salt Lake	UTC/SL
Utility Propane Company	UPPCO
U. S. Department of Justice	USNEP
U.S. Welders Supply Co., Inc.	WESU
Valley Welders Supply Company	VWSC
Valley Welding Supply Co.	VWS-CO
Valley Welding Supply Co., Inc.	VWS
Van Waters & Rogers Inc.	MCKC
Van Waters & Rogers Inc.	MORE
Virginia Welding Supply Company, Inc.	R.V. MAY COMPANY
Virginia Welding Supply Company, Inc.	VAWELD
Virginia Welding Supply Company, Inc.	"MAY COMPANY"
Virginia Welding Supply Company, Inc.	"OXYGEN OF KENTUCKY"
Virginia Welding Supply Co.	VAWELD
Volunteer Welding Supply, Inc.	VOLWS
V&G Welding Supply Inc.	VGW
V&G Welding Supply Inc.	V&G
Waco Welder's Supply Co., Inc.	WAWESCO
Wagner Welding Supply Co.	WWSLC
Waukegan Welding Supply Co. Inc.	WAUK
Wayne Oxygen Company, Inc.	WAYNE
Wayne Oxy. & Welding Sup. Co.	WO&WS
Weber Welding Supply Company	WEBCO
Weber Welding Supply Company	WEBWELD
Weiler Welding Co., Inc.	WWCO
Weldco, Inc.	WELDCO

Weldco, Inc.	WPB
Welders Equipment Company	WEVCCT
Welders Industrial Supply Co., Inc.	WISCO
Welders Supply	WELSUP
Welders Supply, Inc.	WSEP
Welders Supply, Inc.	WSI
Welders Supply, Inc.	WSIPC
Welders Supply, Inc.	WSJ
Welders Supply Company	WELSP
Welders Supply Co.-Beloit, Inc.	WELDSUP
Welders Supply Service, Inc.	KOLL
Welders Sup. Co. of Louisville	SPGASLOU
Welders Sup. Co. of Louisville	WELOFLOU
Welder's Products & Service, Inc.	DDRCO
Welder's Products & Service, Inc.	EDOXKC
Welder's Products & Service, Inc.	WELPDSER
Welding Engineering & Supply Co.	RJP/EWS
Welding Engineering Supply Co.	WESCO-P
Welding Equip. & Supply Co.	B DAVIS
Welding Products of Georgia Inc.	WPGI
Welding Products of Texas, Inc.	WELDPRO
Welding Prod. of Kentucky, Inc.	WPKY
Welding Supply House, Inc.	D&HCO
Welding Supply House, Inc.	WSHSE
Welding & Supply Co., Inc.	PBC-FLA
Welding & Supply Co., Inc.	WASCO
Welding & Therapy Service, Inc.	WTSI
Weldinghouse, Inc.	W-Under Roof/Underlined in a circle.
Welsco, Inc.	WELSCO
Welsco, Inc.	WESUCO
Wesco Redwood, Inc.	WESCO OF CAL
Wesco Redwood Inc.	BMV
Wesco Redwood Inc.	WWS CAL
West Penn Laco, Inc.	WESPEN
West Texas Welders Supply, Inc.	WTWS
West Welding Supply	TWSST
West Welding Supply	WWSST
Western Washington Welding, Inc.	WWWD
Western Welding Supply Co., Inc.	WESTWS

Whitey Company	WHITEY
Whitmore Oxygen Company	WOCO
Willard C. Starcher, Inc.	STARCHER
Willett Bros., Inc.	WILLETT
Wilson Oxygen and Supply Co., Inc.	AS&MC
Wilson Oxygen & Supply Co., Inc.	WILOX
Wright Brothers, Inc.	WBI

NAMES AND ADDRESSES OF REGISTERED CYLINDER OWNERS

A & A Welder's Supply, Inc.	7232 SE 82nd Ave.	Portland, OR 97266
ABSCO Distributing	570 Alaska Ave.	Torrance, CA 90503
Acetylene Gas Company	3500 Bernard St.	St. Louis, MO 63103
Acetylene Products Co., Inc.	1760 S. Harding St.	Indianapolis, IN 46221
Adirondack Bottled Gas Corp.	287 Main St.	Gt. Barrington, MA 01230
AETNA Gas Products, Inc.	Box 304 Homestead Road	Belle Mead, NJ 08502
AGA Gas, Inc.	6225 Oaktree Blvd.	Cleveland, OH 44131
AIFA Products/Morton Thiokol, Inc.	152 Andover St.	Danvers, MA 01923
Air Products & Chemcials, Inc.	Box 538	Allentown, PA 18105
Airco Gases	575 Mountain Avenue	Murray Hill, NJ 07974
Akron Oxygen and Supply Co., Inc.	240 E. South St.	Akron, OH 44311
All Pure Chemical Co., Inc.	26700 S. Banta Rd.	Tracy, CA 95376
Allied Corp. Engd. Mat'ls. Sector	P.O. Box 1139R	Morristown, NJ 07960
Allied-Signal Inc.	P.O. Box 1139R	Morristown, NJ 07960
Amarillo Coca-Cola Bottling Co.	701 S. Lincoln	Amarillo, TX 79105
Amerex Corporation	7595 Gadsden Hwy.	Trussville, AL 35173
American Compressed Gases, Inc.	189 Central Ave.	Old Tappan, NJ 07675
American Industrial Gases, Inc.	1819 Gilford Ave.	New Hyde Park, NY 11040
American Oxygen Company, Inc.	9232 St. Vincent Ave.	Shreveport, LA 71106
American Welding Supply	441 Hobson Street	San Jose, CA 95115
Andrus Equipment Corp.	8300 S. Atlantic Ave.	Cudahy, CA 90201
Ansul Tank Manfacturing	417 - 7th St.	Menominee, MI 49858
Approved Fire Protection Co.	911 Route 22-West	N. Plainfield, NJ 07060
Arco Welding Supply Co., Inc.	1200 Eastern Ave.	Malden, MA 02148
Arizona Welding Equipment Co.	4030 W. Lincoln St.	Phoenix, AZ 85009
Arkansas Specialty Co., Inc.	162 Industrial Road	El Dorado, AR 71731
Arthur's Sales & Service, Inc.	523 E. Andy Devine Ave.	Kingman, AZ 86402
Ashland Chemical Company	PO Box 2219	Columbus, OH 43216
Athens Welding Supply	703 N. Palestine	Athens, TX 75751
AWISCO, Inc.	P.O. Box 5350	San Angelo, TX 76902
A. G. Pond Co.	140 S. Montgomery St.	San Jose, CA 95109
Badger Welding Supplies, Inc.	101 S. Dickinson St.	Madison, WI 53704
Bail Welding Supplies	P.O. Box 368	Gassaway, WV 26624
Barclay Company	720 S. Monroe	Mason City, IA 50401
Barton Welding Supply	Hwy. 71 S. PO Box 1314	Mena, AR 71953
Barton's Welding Supply	901 Seagraves Rd.	Brownfield, TX 79316

Bennett Welding Supply Corporation	806 Broadway PO Box 499	Rockford, IL 61108
Big Three Industries, Inc.	P.O. Box 3047	Houston, TX 77253
Big Three Lincoln Alaska Inc.	6415 Arctic Blvd.	Anchorage, AK 99518
Bird Space Technology	P.O. Box 817	Sandpoint, ID 83864
Blackhawk Gases & Supply Co.	P.O. Box 25	So. Beloit, IL 61080
Bob Smith Corp.	2324 S. College Ave.	Bryan, TX 77805
Bock Bros. Welding Supply Co.	3487-5th Ave. So.	Fort Dodge, IA 50501
Bower Ammonia & Chemical Co.	5811 Tacony Street	Philadelphia, PA 19135
Brand Dry Ice Inc.	101 Truxtun Ave.	Bakersfield, CA 93301
Brooks Welding Supply Company	700 Manufactures Rd.	Chattanooga, TN 37401
Brown Welding Supply, Inc.	253 N. Santa Fe	Salina, KS 67401
Buckeye Corporation	4969 Southway St., S.W.	Canton, OH 44706
Buckeye Welder Services, Inc.	4579 Sutphen Ct.	Hilliard, OH 43026
Buffalo Welding Supply Co., Inc.	396 Grand Island Blvd.	Tonawanda, NY 14150
Butler Gas Products Co.	Nichol Ave.	McKees Rocks, PA 15136
BWS, Inc.	2701 Fruitvale Ave.	Bakersfield, CA 93308
B. Barer & Sons, Inc.	11 N. 4th Ave.	Walla Walla, WA 99362
Caldwell Welding Supply Company	420 N. Beckham St.	Tyler, TX 75702
California Welding Supply Co.	817 S. Center St.	Stockton, CA 95206
Cameron Welding Supply	11061 Dale St.	Stanton, CA 90680
Canadian Cylinder Co. Ltd.	63 Morton Ave. E.	Brantford, ON N3T 5T3 CANADA
Canadian Liquid Air Ltd.	1155 Sherbrooke St. W.	Montreal, PQ H3A 1H8 CANADA
Capital Welding Sup. Co. Inc.	900 E. 2nd St.	Little Rock, AR 72203
Capitol Corporation	233 E. Rankin St.	Jackson, MS 39205
Capitol Oxygen Company Limited	630 Rivermede Road, #2	Concord, ON L4K 2H7 CANADA
Cascade Airgas Inc.	4501 Airport Way S.	Seattle, WA 98108
Cee Kay Supply, Inc.	4241 Folsom Ave.	St. Louis, MO 63110
Central Welding Supplies, Inc.	247 Broadway	Quincy, IL 62306
Cen-Tex Gas, Inc.	2501 S. Pearl	Belton, TX 76513
Clovis Equipment & Supply Company	821 E. 2nd St.	Clovis, NM 88101
Coast Welding Supply	916 W. Betteravia Rd.	Santa Maria, CA 93455
Compositek Engineering Corporation	1095 Columbia St.	Brea, CA 92621
Continental Chemical Company	2175 Acoma St.	Sacramento, CA 95815-3598
Conwin Carbonic Co.	4510 Sperry St.	Los Angeles, CA 90039
Cook's Gas Inc.	305 Parkway	Homestead, FL 33030
Corp Brothers, Inc.	One Brook St.	Providence, RI 02903
Coss Welding Supply, Inc.	400 W. Memorial Blvd.	Hagerstown, MD 21740
Coyne Cylinder Company	521 Green Cove Road	Huntsville, AL 35803
Crumpton Welding Sup. & Equip. Inc.	1602 - 34th St.	Tampa, FL 33605

Cryo Dyne Corp.	Payne Rd. PO Box 90	Danbury, CT 06813
Cutting Fuels, Inc.	P.O. Box 429	Shawnee, OK 74802-0429
C. W. Pulver, Inc.	Montauk Highway	Bridgehampton, NY 11932
Dakota Welding Supply Co., Inc.	4100 N. Cliff Ave.	Sioux Falls, SD 57101
Dalox Welding Supply Co.	2306 N. Beckley Ave.	Dallas, TX 75208
David Soda Dispensing Co.	115 Cross St.	Forestville, CT 06010
Dempsey Enterprises	465 Knollwood Road	White Plains, NY 10603
Denton Welding Supply	3302 Broadway	Galveston, TX 77550
Depke Welding Supplies, Inc.	628 E. Williams St.	Danville, IL 61834
Detroit Gas Products Co.	1200 Farrow	Ferndale, MI 48220-2091
Dixie Oxygen Co., Inc.	651 Magnolia Ave.	Lexington, KY 40505
Doansco Welding Supply	2881 Tylersville Rd.	Hamilton, OH 45015
Eagle Air Systems	P.O. Box 458	Pleasant Garden, NC 27313
Earl's Welders Supply Company	1235 W. Danville St.	South Hill, VA 23970
East Texas Oxygen Company	Rt. 12, Box 12205	Tyler, TX 75708
Ekohwerks Company	1924 E. 337th St.	Eastlake, OH 44094
Etex, Inc.	P.O. Box 978	Kilgore, TX 75662
Etox, Inc.	P.O. Box 3549	Lufkin, TX 75903
Eureka Oxygen Co.	109 T St.	Eureka, CA 95501
Evans Welding Supply Co., Inc.	1405 W. Market St.	Johnson City, TN 37601
Exodus, Ltd.	P.O. Box 330	Des Moines, IA 50302
E.I. du Pont de Nemours & Co.	Mats. & Logistics Dept.	Wilmington, DE 19898
Farmers Elevator Co.	Box 186	Mullen, NE 69152
Findley Welding Supply, Inc.	700 Mahoning Bank Bldg.	Youngstown, OH 44501
Franke Filling, Inc.	5960 Tension Dr.	Fort Worth, TX 76124-0209
Fred E. Barnett Co.	3080 N. State St.	Ukiah, CA 95548
G & E Welding Supply Co. Inc.	281 Airport Rd.	New Castle, DE 19720
Gas Systems, Inc.	5361 Production Dr.	Huntington Beach, CA 92649-1584
General Air Service & Supply Co.	1105 Zuni Street	Denver, CO 80204
General Cryogenics Corporation	1215 Henderson Ave.	Washington, PA 15301
General Gases & Supplies Corp.	G.P.O. Box 3868	San Juan, PR 00936-3868
General Welding Supply Co.	1122 W. Rosecrans Ave.	Gardena, CA 90247
General Welding Supply Co.	3623 E. Marginal Way S.	Seattle, WA 98134
General Welding Supply Co.	1st & Lombard St.	Martins Ferry, OH 43912
General Welding Supply Co.	P.O. Box 5105-Y	Tampa, FL 33675
Gerin Welding Sales, Inc.	2020 De La Cruz Blvd.	Santa Clara, CA 95050-3096
Greco Welding Supplies, Inc.	Route 28, PO Box 349	Tarentum, PA 15084
G. P. Modlish, Inc.	102 S. Church St.	Jennings, LA 70546-0892
Hammack Welding Supply, Inc.	319 S. White Sands Bd.	Alamogorado, NM 88310

Harris Calorific Sales. Inc.	9030 W. Schlinger Ave.	West Allis. WI 53214
Haun Welding Supply Inc.	6000 Ct. St. Rd.	Syracuse. NY 13206
Herring Welding Supply, Inc.	171 Ross Clark Cir. NE	Dothan. AL 36302
Hinely Air Products. Inc.	2601 S. Division Ave.	Orlando. FL 32802
Hiram Rivera	Centro Gas Fluido	Aguada. PR 00602
Hobart North Welding Supply, Inc.	5439 W. Diversey Ave.	Chicago, IL 60639-1489
Holston Gases. Inc.	222 Council St.	Knoxville. TN 37927-3353
Hoprich Co. Inc.	2300 N. Burkhardt Rd.	Evansville. IN 47715
Houston Lighting & Power Co.	P.O. Box 1700	Houston. TX 77001
Huber Supply Co., Inc.	1527 North Federal Ave.	Mason City, IA 50401
Hust Bros. Inc.	712 - 3rd St. Box 591	Marysville. CA 95901
ICG Liquid Gas Ltd.	444 St. Mary Ave.	Winnipeg, MB R3C 3T7 CANADA
ICI Americas Inc.	333 Main St.	Dighton. MA 02715
IGO'S Welding Supply Co.. Inc.	205 Grove St.	Watertown. MA 02172
Industrial Gas & Supply Co.	P.O. Drawer 960	Bluefield. WV 24701
Industrial Oxygen Co.. Inc.	7th & Myrtle Sts.	Louisville. KY 40208
Industrial Safety Equip Co.. Inc.	1705 Baker Dr. Box 2879	Sherman. TX 75090
Industrial Sales & Leasing	702 Culebra Ave.	San Antonio. TX 78201
Industrial Welding Supplies Inc.	6545 - 5th Pl. S.	Seattle, WA 98108
Industrial Welding Supply, Inc.	4 Val St.	Sayreville. NJ 08872
Industrial Welding Supply Inc.	3415 S. Pacific Blvd.	Albany, OR 97321
Interstate Ind. of New Jersey	2120 Lamberts Mill Rd.	Scotch Plains. NJ 07076
Interstate Welding Sales Corp.	1801 Marinette Ave.	Marinette. WI 54143-0257
Inweld Corporation	5353 W. Southern	Indianapolis. IN 46241
Island Equipment Co.	3200 N.W. Yeon	Portland. OR 97210
J A Welding Supply Co.. Inc.	102 Colquhoun St.	Danville. VA 24541
Jack B. Kelley Company	Rt. 1. Box 400	Amarillo. TX 79106
Jackson Welding Supply Co.. Inc.	533 Buffalo Rd.	Rochester. NY 14611
Jackson Welding Supply Co. Inc.	600 Airways Blvd.	Jackson. TN 38301
James Oxygen & Supply Co.	30 Hwy. 321 NW	Hickory. NC 28601
Jones Chemicals. Inc.	100 Sunny Sol Blvd.	Caledonia. NY 14423
Jones Welders Supply	3700 E. Tuxedo Blvd.	Bartlesville. OK 74006
Keen Compressed Gas Co., Inc.	101 Rogers Rd.	Wilmington. DE 19899
Keen Welding Supplies. Inc.	109 W. Gordy Rd.	Salisbury. MD 21802-2356
Keystone Metal Welding Supply, Inc.	2510 New Butler Rd.	New Castle. PA 16107
Kirk Welding Supply	1608 Holmes	Kansas City, MO 64108-1589
Langdon Oxygen Company	3503 W. 7th St.	Texarkana. TX 75501
LaRoche Industries Inc.	1100 Johnson Ferry NE	Atlanta. GA 30342
Layman Welding Supply Co.	1000 Scribner Ave., NW	Grand Rapids. MI 49504

Lincoln Big Three, Inc.	1350 Choctaw Dr.	Baton Rouge, LA 70821
Linde Gas of the West	420 River Rd.	Modesto, CA 95351
Liquid Air Corporation	933 Lee Road #202	Orlando, FL 32810
Liquid Carbonic Inc.	255 Brimley Road	Scarborough, ON M1M 3J2 CANADA
Liquid Carbonic Specialty Gas	135 S La Salle Street	Chicago, IL 60603-4282
Liquid Gas Co.	307 W. Main	Enterprise, OR 97828
Logan Hagan Welding Supply, Inc.	303 N. Zetterower Ave.	Statesboro, GA 30458
L. Miller & Son, Inc.	606 Triana Blvd. N.W.	Huntsville, AL 35805
L. V. Paul & Sons Equipment Corp.	P.O. Box 458	West Grove, PA 19390
Machine & Welding Supply Company	Highway 301 S. Box 1708	Dunn, NC 28334
Magna-Fab Industries Inc.	Box 308/#1 E. First St.	O'Fallon, IL 62269
Mansfield Oxygen Corporation	4969 Southway St. S.W.	Canton, OH 44706
Marse Welding Supplies, Inc.	2700 Hessmer Ave.	Metairie, LA 70002
Matheson Gas Products	30 Seaview Dr.	Secaucus, NJ 07094
Mathews Chemical & Supply Co., Inc.	2591 Faivre St. Bdg 1	Chula Vista, CA 92011
McMillan Supply Company	242 S. Walnut St.	Greenville, MS 38702-0130
Metalweld, Inc.	Rt. 2 Sadler Chapel Rd.	Dexter, MO 63841
Metrolina Welding Inc.	2288 South Blvd.	Charlotte, NC 28203
MG Industries	2460 Blvd. of the Generals	Valley Forge, PA 19482
Miami Industrial Gases, Inc.	3735 N. W. 81 Street	Miami, FL 33147
Michiana Welding Supply, Inc.	730 East Sample Street	South Bend, IN 46618
Midwest Bottle Gas Co.	3600 Hwy. 157, Box 429	LaCrosse, WI 54602
Midwest Welding Supply, Inc.	5318 S. Kedzie St.	Chicago, IL 60632
Mid-State Welding Supply, Inc.	1523 Salisbury Rd.	Statesville, NC 28677
Mississippi Welders Sup. Co., Inc.	4520 W. 6th St.	Winona, MN 55987-1036
Mississippi Welding Supply, Inc.	615 Robert E. Lee Dr.	Tupelo, MS 38801-5586
Missouri Oxygen Co.	2300 W. Main St.	Sedalia, MO 65301
Modern Gas Co., Inc.	Woodbine-Ocean View Rd.	Woodbine, NJ 08270
Modern Gas Service Corporation	150 Meadowland Pky.	Secaucus, NJ 07094
Monarch Chemicals, Inc.	37 Meadow St.	Utica, NY 13503
Monroe Welding Supply, Inc.	410 N. 18th St.	Monroe, LA 71201
Moore Bros.	1725-69th St.	Sacramento, CA 95819
Moore's Welding Supply Co.	1101 So. 8th St.	St. Joseph, MO 64503
Nanco Inc.	One Railroad Ave.	Amesbury, MA 01913
National Ammonia Co.	Tacony & Vankirk Sts.	Philadelphia, PA 19135
National Dry Ice	139 No. Mt. Vernon	San Bernardino, CA 92410
National Welders Supply Company, Inc.	810 Gesco Street	Charlotte, NC 28231
National Welding Supply, Inc.	2550 Harrison St.	Batesville, AR 72503
National Welding Supply Co. (Inc.)	P.O. Box 4709	Fort Worth, TX 76164

New Bedford Welding Supply, Inc.	272 Herman Melville	New Bedford, MA 02740
New Hampshire Welding Sup. Corp.	8001 S. Willow St.	Manchester, NH 03108
Newton Welding Supply, Inc.	RFD 1 Box 398	Plattsburgh, NY 12901
Nordan Smith Welding Supplies	2700 N. Main St.	Hattisburg, MS 39401
Nordan's Welding & Safety Supply	2700 N. Main St.	Hattisburg, MS 39401
Northeast Airgas, Inc.	8001 S. Willow St.	Manchester, NH 03103
Northeastern Ammonia Co.	Tacony & Vankirk Sts.	Philadelphia, PA 19135
Northern Welding & Supply	5600 Packer Dr.	Wausau, WI 54401
N. Collins Cylinder Gas Co., Inc.	1770 Mile Strip Rd.	North Collins, NY 14111
OXARC, Inc.	716 S. Oregon Ave.	Pasco, WA 99301
Oxygen Sales & Service, Inc.	2043 S. 35th St.	Tacoma, WA 98409
Oxygen Service Company	529 Southwest Blvd.	Kansas City, MO 64108
Oxygen & Welding Supply Co., Inc.	P.O. Box 337	White River Jct., VT 05001
Ozark Fire Entinguisher, Inc.	2049 E. Division	Springfield, MO 65803
O. E. Meyer Co.	2016 Milan Rd.	Sandusky, OH 44870
Parrish Welding Supply, Inc.	2670 Phyllis St.	Jacksonville, FL 32204-2640
Patsems, Inc.	25 Warren Pl.	Mt. Vernon, NY 10550
Paul Carroll Welding Supply, Inc.	902 N. 10th PO Box 1857	Abilene, TX 79604
Pennsylvania Engineering Company	1107-21 N. Howard St.	Philadelphia, PA 19123
Pennwalt Corporation	Three Parkway	Philadelphia, PA 19102
People Greeters	22150 Wallace Dr.	Cupertino, CA 95014
Phoenix Research Corporation	8075 Alvarado Road	La Mesa, CA 92042
Phoenix Welding Supply	3024 N. Peck Rd.	El Monte, CA 91731
Plains Welding Supply, Inc.	401 E. 6th St.	Plainview, TX 79072
Pocahontas Welding Supply Co.	P.O. Box 1268	Charleston, WV 25325
Potomac Airgas	5192 Raynor Road	Linthicum, MD 21090
Pressed Steel Tank Co., Inc.	1445 S. 66 St.	Milwaukee, WI 53201
Propane Power Corporation	981 Delancy St.	Newark, NJ 07105
Purdue University	Gen. Stores Svc. Bldg.	W. Lafayette, IN 47907
Puritan-Bennett Corporation	10800 Pflumm Rd.	Lenexa, KS 66215
P. G. Walker & Son, Inc.	1404 College St.	Springfield, MO 65801-0762
R & R Welding Supply Co.	P.O. Box 188	Des Moines, IA 50301
Racon Inc.	P.O. Box 198	Wichita, KS 67201
Raimy Corporation	1628 Cascade St.	Erie, PA 16502
Red Ball Oxygen Co., Inc.	609 N. Market St.	Shreveport, LA 71107
Reynolds Welding Supply Co.	1728 N. Front St.	Mankato, MN 56001
Rice Welding Supply Co., Inc.	10141 Market St.	Houston, TX 77029
Richard Welding Equipment, Inc.	307 W. Plaquemine St.	Jennings, LA 70546
Riggs Welders Supplies, Inc.	1825 Arnold Indus. Way	Concord, CA 94520-5397

Rite Weld Supply, Inc.	3417 N. Main St.	Ft. Worth, TX 76106
Roberts Oxygen Company, Inc.	15830 Redland Road	Rockville, MD 20855
Rockford Ind. Welding Supply	2935 Eastrock Dr.	Rockford, IL 61125
R.I. Welding Supply Co., Inc.	P.O. Box 660	E. Greenwich, RI 02818
San Diego Welders Supply, Inc.	2506 Market St.	San Diego, CA 92102
Sawtelle & Rosprim Hardware, Inc.	1161 North Avenue	Corcoran, CA 93212
Schultz Gas Service, Inc.	17704 Paxton Ave.	Lansing, IL 60438-1518
Scott Specialty Gas	Rte. 611	Plumsteadville, PA 18949
Scott - Gross Co., Inc.	664 Magnolia Ave.	Lexington, KY 40505-3789
Scott-Marrin, Inc.	2001 Third St., Unit H	Riverside, CA 92507
Scully Welding Supply Corp.	Oak Ave./B&O RR Box 333	Collingdale, PA 19023
Selox, Inc.	821 E. 11th St.	Chattanooga, TN 37401
Shaw Oxygen Co., Inc.	2914 DeSiard St.	Monroe, LA 71201
Sims Welding Supply Co., Inc.	18903 S. Main St.	Gardena, CA 90248
Soda System	30 Harold Court	Bayshore, NY 11706
Sooner Supplies, Inc.	1229 N. Harrison	Shawnee, OK 74802-0429
SOS Gases Inc.	1100 Harrison Ave.	Kearny, NJ 07029
Southern Welding Supply, Inc.	1025 W. Lathrop Ave.	Savannah, GA 31402
Southern Welding Supply Co.	3000 Industrial Dr.	Bowling Green, KY 42102
Southern Welding Supply Inc.	50 McDonald St.	Tarrant, AL 35217-0488
Spoon Automotive Parts, Inc.	216 W. Market St.	Aberdeen, WA 98520
Steel Cylinder Mfrg. Ltd.	97 Lyon Ave. N.	Tilbury, Ont. N0P 2L0 CANADA
Strate Welding Supply Co., Inc.	101 Comet St.	Buffalo, NY 14216
Suburban Propane Gas, Inc.	P.O. Box 640	Sumter, SC 29151
Suburban Welders Supply Co., Inc.	72 Nickerson Rd.	Ashland, MA 01721
Sunox, Inc.	4236 Statesville Rd.	Charlotte, NC 28213
Sunset Wire Rope Company	518 Marine Dr.	Port Angeles, WA 98362
Superior Welding Supply	109 Lange Ln.	Angola, IN 46703
Superior Welding Supply Co.	W. 7 & Commercial Sts.	Waterloo, IA 50704
Tampa Oxygen & Welding Supply, Inc.	3102 Fourth Ave.	Tampa, FL 33605
Tanx Co.	3660-A Parkway Lane	Hilliard, OH 43026
Taylor-Wharton, Div. of HARSCO	P.O. Box 2365	Harrisburg, PA 17105
Terrace Supply Company	710 N. Addison Rd.	Villa Park, IL 60181
Terry Supply Company	6211-17th St. East	Bradenton, FL 34203
TEWECO, Inc.	1820 Irving Blvd.	Dallas, TX 75207
Texas Industrial Gas, Inc.	4700 S. Loop East	Houston, TX 77033
Texas Oxygen, Inc.	P.O. Box 430386	Houston, TX 77243-0386
The Ansul Company	One Stanton St.	Marinette, WI 54143
The Home Gas Corporation	287 Main St.	Great Barrington, MA 01230

The Price-Bass Co., Inc.	2960 Sidco Dr.	Nashville, TN 37204
Thomas Gas Service, Inc.	1045 W. Jefferson St. RR 3	Greenfield, OH 45123
Thornton Enterprises	94 W. Forest Grove Rd.	Vineland, NJ 08360-0086
Timco Welding Supply	111 East Ave. F	Killeen, TX 76541
Toledo Oxygen & Equipment Company	1310 Elm St.	Toledo, OH 43608
Town & Country Gas Service Inc.	Box 935	Coloma, MI 49038
Trinity Industries, Inc.	2525 Stemmons Freeway	Dallas, TX 75207
Trinity Industries, Inc.	811 West Ave.	Cedartown, GA 30125
Union Carbide Canada Ltd.	123 Eglinton Ave. East	Toronto, Ont. M4P 1J3 CANADA
Union Carbide Linde Division	200 Cottontail Lane	Somerset, NJ 08875-6744
United States Welding Inc.	600 S. Santa Fe	Denver, CO 80223
United Welding Supply Co. Inc.	P.O. Box 295	Amsterdam, NY 12010
Urie and Blanton	138 Keystone Rd.	Chester, PA 19014
Utah Tech. College at Salt Lake	P.O. Box 30808	Salt Lake City, UT 84130
Utility Propane Company	One Elizabethtown Plaza	Elizabeth, NJ 07207
U. S. Department of Justice	Bureau of Prisions U.S. Pen.	Lewisburg, PA 17837
U.S. Welders Supply Co., Inc.	1800 Fifth Ave.	River Grove, IL 60173
Valley Welders Supply Company	2801 Princeton Dr. N.E.	Albuquerque, NM 87107
Valley Welding Supply Co.	67 - 43rd St.	Wheeling, WV 26003
Valley Welding Supply Co., Inc.	29 Moore St.	Binghamton, NY 13903
Van Waters & Rogers Inc.	P.O. Box 2169	Spartanburg, SC 29304
Virginia Welding Supply Company, Inc.	One Oregon Street Boc 1268	Charleston, WV 25325
Volunteer Welding Supply, Inc.	815-5th Ave. S.	Nashville, TN 37203
V&G Welding Supply Inc.	805 Highway 1 North	Greenville, MS 38701
Waco Welder's Supply Co., Inc.	1101 Clay PO Box 6168	Waco, TX 76706
Wagner Welding Supply Co.	10 Gay St., Box 161	Longmont, CO 80501
Waukegan Welding Supply Co. Inc.	1201 Belvidere St.	Waukegan, IL 60085
Wayne Oxygen Company, Inc.	2615 S. 40th St.	Phoenix, AZ 85034
Wayne Oxy. & Welding Sup. Co.	1022 W. Main St.	Waynesboro, VA 22980
Weber Welding Supply Company	3220 Smallman St.	Pittsburgh, PA 15201
Weiler Welding Co., Inc.	324 E. Second St.	Dayton, OH 45402-1759
Weldco. Inc.	2618 N.W. 103rd St.	Miami, FL 33147
Welders Equipment Company	203 N. Ben Jordan	Victoria, TX 77902
Welders Industrial Supply Co., Inc.	P.O. Box 96115	Houston, TX 77213-6115
Welders Supply	413 - 7th St. N.E.	Childress, TX 79201
Welders Supply, Inc.	605 Clifton St.	Jackson, MS 39207
Welders Supply, Inc.	500 Bethel St.	Paducah, KY 42002-7309
Welders Supply, Inc.	1610 Florida Ave.	Panama City, FL 32401
Welders Supply, Inc.	430 S. Industrial	Dallas, TX 75207

Welders Supply Company	4000 - 7th Ave. South	Seattle, WA 98108
Welders Supply Co.-Beloit, Inc.	111 Barrett Pl.	Beloit, WI 53511
Welders Supply Service, Inc.	420 River Rd.	Modesto, CA 95351
Welders Sup. Co. of Louisville	335 Boxley Ave.	Louisville, KY 40213
Welder's Products & Service, Inc.	3107 Roanoke Rd.	Kansas City, MO 64111
Welding Engineering & Supply Co.	P.O. Box 974	Santa Fe, TX 77510
Welding Engineering Supply Co.	940 N. Craft Highway	Prichard, AL 36610
Welding Equip. & Supply Co.	2518 E. 3rd St.	Amarillo, TX 79105
Welding Products of Georgia Inc.	2186 Marietta Blvd. NW	Atlanta, GA 30318
Welding Products of Texas, Inc.	8443 Airline Dr.	Houston, TX 77037
Welding Prod. of Kentucky, Inc.	884 Nandino Blvd.	Lexington, KY 40503
Welding Supply House, Inc.	1300 Surrey St.	Lafayette, LA 70501
Welding & Supply Co., Inc.	4571 - 62nd Ave., No.	Pinellas Park, FL 33565
Welding & Therapy Service, Inc.	5010 Crittenden Dr.	Louisville, KY 40213
Weldinghouse, Inc.	9075 Bank St.	Cleveland, OH 44125
Welsco, Inc.	P.O. Box 1058	N. Little Rock, AR 72115
Wesco Redwood, Inc.	947 Broadway	Redwood City, CA 94064
West Penn Laco, Inc.	331 Ohio St.	Pittsburgh, PA 15209-2798
West Texas Welders Supply, Inc.	P.O. Box 5350	San Angelo, TX 76902
West Welding Supply	Rt. 3, Box 376	Sweetwater, TX 79556
Western Washington Welding, Inc.	Monte-Elma Rd.	Satsop, WA 98583
Western Welding Supply Co., Inc.	Hwy. 7 & S. 2nd St.	Duncan, OK 73532
Whitey Company	318 Bishop Road	Highland Heights, OH 44143
Whitmore Oxygen Company	1884 S. 300 W.	Salt Lake City, UT 84125
Willard C. Starcher, Inc.	124 Vandale Ave.	Spencer, WV 25276
Willett Bros., Inc.	863 Main St.	Lewiston, ID 83501
Wilson Oxygen and Supply Co., Inc.	P.O. Box 52	Waco, TX 76730
Wilson Oxygen & Supply Co., Inc.	150 E. Ben White Blvd.	Austin, TX 78764
Wright Brothers, Inc.	1930 Losantiville	Cincinnati, OH 45237

4. REFERENCES

[1] *Code of Federal Regulations*, Title 49 CFR Parts 100-199 (Transportation), U.S. Department of Transportation. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

[2] Transport Dangerous Goods Transport Canada, 344 Slater Street, 14th Floor, Ottawa, Ontario, CANADA K1A 0N5.

APPENDIX M

V-1 — 1987 TABLE 1 — ALPHABETICAL LIST OF GASES AND CONNECTIONS ASSIGNED

GAS			STANDARD		LIMITED STANDARD		ALTERNATE STANDARD
			EXISTING	ADDED IN 1987	EXISTING	ADDED IN 1987	OBSOLETE 1/1/92
Acetylene	Over 50 cu. ft. (1.39 m³)		510			300, 415①	410③
	Between 35 (970 L) and 75 cu. ft. (2.08 m³)				520		
	Approx. 10 cu. ft. (280 L)				200		
Air (R729)	Up to 3000 psig	Threaded	346			590	
	(20 680 kPa)	Yoke	950		850①	855①②	
	3001-5500 psig (20 690-37 900 kPa)			347			
	5501-7500 psig (38 000-51 700 kPa)			702			④
	Cryogenic Liquid Withdrawal		440				
Allene			510				
Allylene: *See Methylacetylene*							
Ammonia (R717)	Threaded		240, 705			660	
	Yoke		800, 845				
Antimony Pentafluoride			330				
Argon	Up to 3000 psig (20 680 kPa)		580				
	3001-5500 psig (20 690-37 900 kPa)			680			677
	5501-7500 psig (38 000-51 700 kPa)			677			
	Cryogenic Liquid Withdrawal		295				
Arsine			350			660	
Bis (trifluoromethyl) Peroxide: *See Hexafluorodimethyl Peroxide*							
Boron Chloride: *See Boron Trichloride*							
Boron Fluoride: *See Boron Trifluoride*							
Boron Trichloride				660			330
Boron Trifluoride			330				
Bromine Pentafluoride			670				
Bromine Trifluoride			670				
Bromoacetone				660			330
Bromochlorodifluoromethane (R12B1)				660	165, 182		668
Bromochloromethane				660	165, 182		668
Bromoethylene: *See Vinyl Bromide*							
Bromomethane: *See Methyl Bromide*							
Bromotrifluoroethylene (R113B1)			510				660
Bromotrifluoromethane (R13B1)				660	165, 182		668
1, 3-Butadiene			510				
Butane (R600)	Gas Withdrawal		510				
	Liquid Withdrawal		555				
1-Butene			510				
2-Butene			510				

① Limited Standard for Canada only. ② Limited to SCUBA (Self-Contained Underwater Breathing Apparatus) use. ③ Was formerly CGA 1310.
④ Connection 677 which had been assigned to include high pressure air in V-1 (1977) became obsolete for air with the publication of V-1 (1987).

V-1 — 1987 TABLE 1 — ALPHABETICAL LIST OF GASES AND CONNECTIONS ASSIGNED (Cont'd.)

GAS		STANDARD		LIMITED STANDARD		ALTERNATE STANDARD
		EXISTING	ADDED IN 1987	EXISTING	ADDED IN 1987	OBSOLETE 1/1/92
α-Butylene: *See 1-Butene*						
β-Butylene: *See 2-Butene*						
1-Butyne: *See Ethylacetylene*						
Carbon Dioxide (R744)	Threaded	320				
	Yoke	940				
Carbonic Acid: *See Carbon Dioxide*						
Carbon Monoxide		350				
Carbon Oxysulfide: *See Carbonyl Sulfide*						
Carbon Tetrafluoride: *See Tetrafluoromethane*						
Carbonyl Chloride: See Phosgene						
Carbonyl Fluoride			660			750
Carbonyl Sulfide		330				
Chlorine	Threaded				660①	
	Yoke	820				
Chlorine Pentafluoride		670				
~~Chlorine Trifluoride~~		670				
1-Chloro-1, 1-difluoroethane (R142b)		510				660
Chlorodifluoromethane (R22)			660	165, 182		668
Chloroethane: *See Ethyl Chloride*						
Chloroethylene: *See Vinyl Chloride*						
Chlorofluoromethane (R31)		510				
Chloroheptafluorocyclobutane (RC317)			660	165, 182		668
Chloromethane: *See Methyl Chloride*						
Chloropentafluoroethane (R115)			660	165, 182		668
1-Chloro-1, 2, 2, 2-tetrafluoroethane (R124)			660	165, 182		668
1-Chloro-2, 2, 2-trifluoroethane (R133a)			660	165, 182		668
Chlorotrifluoroethylene (R1113)		510				660
Chlorotrifluoromethane (R13)			660	165, 182	320	668
Cyanogen			660			750
Cyanogen Chloride			660			750
Cyclobutane		510				
Cyclopropane	Threaded	510				
	Yoke	920				
Deuterium		350				
Deuterium Chloride		330				
Deuterium Fluoride			670		660	330
Deuterium Selenide		350			660	

① For use in the Specialty Gas industry only.

V-1 — 1987 TABLE 1 — ALPHABETICAL LIST OF GASES AND CONNECTIONS ASSIGNED (Cont'd.)

GAS	STANDARD		LIMITED STANDARD		ALTERNATE STANDARD
	EXISTING	ADDED IN 1987	EXISTING	ADDED IN 1987	OBSOLETE 1/1/92
Deuterium Sulfide	330				
Diborane	350				
Dibromodifluoroethane		660	165, 182		668
Dibromodifluoromethane (R12B2)		660	165, 182		668
1, 2-Dibromotetrafluoroethane (R114B2)		660	165, 182		668
1, 2-Dichlorodifluoroethylene		660	165, 182		668
Dichlorodifluoromethane (R12)		660	165, 182		668
1, 2-Dichloroethylene (R1130)		660	165, 182		668
Dichlorofluoromethane (R21)		660	165, 182		668
1, 2-Dichlorohexafluorocyclobutane (RC316)		660	165, 182		668
Dichlorosilane		678			330
1, 1-Dichlorotetrafluoroethane (R114a)		660	165, 182		668
1, 2-Dichlorotetrafluoroethane (R114)		660	165, 182		668
2, 2-Dichloro-1, 1, 1-trifluoroethane (R123)		660	165, 182		668
Dicyan: *See Cyanogen*					
Diethylzinc		510			750
Difluorodibromoethane: *See Dibromodifluoroethane*					
Difluorodibromomethane *See Dibromodifluoromethane*					
1, 1-Difluoroethane (R152a)	510				660
1, 1-Difluoroethylene (R1132a)	350				
Difluoromethane: *See Methylene Fluoride*					
Difluoromonochloroethane: *See Chlorodifluoroethane*					
Dimethylamine	705				240
Dimethyl Ether	510				
Dimethylhexafluoroperoxide: *See Hexafluorodimethyl Peroxide*					
2, 2-Dimethylpropane	510				
Dinitrogen Oxide: *See Nitrous Oxide*					
Dinitrogen Tetroxide: *See Nitrogen Dioxide*					
Dinitrogen Trioxide: *See Nitrogen Trioxide*					
Diphosgene		660			750
Epoxyethane: *See Ethylene Oxide*					
Ethane (R170)	350				
Ethene: *See Ethylene*					

V-1 — 1987 TABLE 1 — ALPHABETICAL LIST OF GASES AND CONNECTIONS ASSIGNED (Cont'd.)

GAS			STANDARD		LIMITED STANDARD		ALTERNATE STANDARD
			EXISTING	ADDED IN 1987	EXISTING	ADDED IN 1987	OBSOLETE 1/1/92
Ethylacetylene			510				
Ethylamine: *See Monoethylamine*							
Ethyl Chloride (R160)				300			510
Ethyldichloroarsine				660		—	750
Ethylene (R1150)		Threaded	350				
		Yoke	900				
Ethylene dichloride: *See Dichloroethylene*							
Ethylene Oxide			510				
Ethyl Ether			510				
Ethyl Fluoride				660			750
Ethylidene Fluoride: *See 1, 1-Difluoroethane*							
Ethyl Methyl Ether: *See Methyl Ethyl Ether*							
Ethyne: *See Acetylene*							
Fluorine			679				
Fluoroethylene: *See Vinyl Fluoride*							
Fluoroform (R23)				660	165, 182	320	668
Fluoromethane: *See Methyl Fluoride*							
Gases in Small Cylinders: *See "Introduction" Par. 2.8*							
Germane				350		660	750
Helium	Up to 3000 psig	Threaded	580				
	(20 680 kPa)	Yoke	930				
	3001-5500 psig (20 690-37 900 kPa)			680			677
	5501-7500 psig (38 000-51 700 kPa)			677			
	Cryogenic Liquid Withdrawal		792				
Heptafluorobutyronitrile				660			750
Hexafluoroacetone			330				660
Hexafluorocyclobutene				660			750
Hexafluorodimethyl Peroxide				660			755
Hexafluoroethane (R116)				660	165, 182	320	668
Hexafluoro-2-propanone: *See Hexafluoroacetone*							
Hexafluoropropylene				660	165, 182		668
Hydriodic Acid, Anhydrous: *See Hydrogen Iodide*							
Hydrobromic Acid, Anhydrous: *See Hydrogen Bromide*							
Hydrochloric Acid, Anhydrous: *See Hydrogen Chloride*							
Hydrocyanic Acid, Anhydrous: *See Hydrogen Cyanide*							

V-1 — 1987 TABLE 1 — ALPHABETICAL LIST OF GASES AND CONNECTIONS ASSIGNED (Cont'd.)

GAS		STANDARD		LIMITED STANDARD		ALTERNATE STANDARD
		EXISTING	ADDED IN 1987	EXISTING	ADDED IN 1987	OBSOLETE 1/1/92
Hydrofluoric Acid, Anhydrous: *See Hydrogen Fluoride*						
Hydrogen	Up to 3000 psig (20 680 kPa)	350				
	3001-5500 psig (20 690-37 900 kPa)		695			677
	5501-7500 psig (38 000-51 700 kPa)		703			677
	Cryogenic Liquid Withdrawal	795				
Hydrogen Bromide		330				
Hydrogen Chloride		330				
Hydrogen Cyanide			660			750
Hydrogen Fluoride			670		660	330
Hydrogen Iodide		330				
Hydrogen Selenide		350			660	
Hydrogen Sulfide		330				
Industrial Gas Mixtures: *See CGA Pamphlet V-7*						
Iodine Pentafluoride		670				
Isoamylene: *See 3-Methyl-1-butene*						
Isobutane (R601)		510				
Isobutene: *See Isobutylene*						
Isobutylene		510				
Isopropylethylene: *See 3-Methyl-1-butene*						
Krypton	Up to 3000 psig (20 680 kPa)	580				
	3001-5500 psig (20 690-37 900 kPa)		680			677
	5501-7500 psig (38 000-51 700 kPa)		677			
Laughing Gas: *See Nitrous Oxide*						
Lewisite (Dichloro (2-chlorovinyl) arsine)			660			750
Liquid Dioxide: *See Nitrogen Dioxide*						
Marsh Gas: *See Methane*						
Medical Gas Mixtures: *See Table 2, page 23*						
Methane (R50)	Up to 3000 psig (20 680 kPa)	350				
	3001-5500 psig (20 690-37 900 kPa)		695			677
	5501-7500 psig (38 000-51 700 kPa)		703			677
	Cryogenic Liquid Withdrawal	450				
Methanethiol: *See Methyl Mercaptan*						
Methoxyethylene: *See Vinyl Methyl Ether*						
Methylacetylene		510				
Methylamine: *See Monomethylamine*						
Methyl Bromide		330			320	
3-Methyl-1-butene		510				
Methyl Chloride (R40)		510			660	

V-1 — 1987 TABLE 1 — ALPHABETICAL LIST OF GASES AND CONNECTIONS ASSIGNED (Cont'd.)

GAS	STANDARD		LIMITED STANDARD		ALTERNATE STANDARD
	EXISTING	ADDED IN 1987	EXISTING	ADDED IN 1987	OBSOLETE 1/1/92
Methyldichloroarsine		660			750
Methylene Fluoride (R32)	320				
Methyl Ether: *See Dimethyl Ether*					
Methyl Ethyl Ether	510				
Methyl Fluoride (R41)	350				
Methyl Iodide		660			
Methyl Mercaptan	330				750
2-Methylpropene: *See Isobutylene*					
Methyl Vinyl Ether: *See Vinyl Methyl Ether*					
Monochlorodifluoromethane: *See Chlorodifluoromethane*					
Monochloropentafluoroethane: *See Chloropentafluoroethane*					
Monochlorotetrafluoroethane: *See Chlorotetrafluoroethane*					
Monochlorotrifluoromethane: *See Chlorotrifluoromethane*					
Monoethylamine (R631)	705				240
Monomethylamine (R630)	705				240
Mustard Gas [Bis (2-chloroethyl) Sulfide]		660			750
Natural Gas — Up to 3000 psig (20 680 kPa)	350				
3001-5500 psig (20 690-37 900 kPa)		695			677
5501-7500 psig (38 000-51 700 kPa)		703			677
Cryogenic Liquid Withdrawal	450				
Neon — Up to 3000 psig (20 680 kPa)	580				
3001-5500 psig (20 690-37 900 kPa)		680			677
5501-7500 psig (38 000-51 700 kPa)		677			
Cryogenic Liquid Withdrawal	792				
Neopentane: *See 2, 2-Dimethylpropane*					
Nickel Carbonyl		660			750
Nickel Tetracarbonyl: *See Nickel Carbonyl*					
Nitric Oxide		660			755
Nitrogen — Up to 3000 psig (20 680 kPa) — Threaded	580			555, 590	
Yoke	960				
3001-5500 psig (20 690-37 900 kPa)		680			677
5501-7500 psig (38 000-51 700 kPa)		677			
Cryogenic Liquid Withdrawal	295				
Nitrogen Dioxide		660			160, 755
Nitrogen Peroxide: *See Nitrogen Dioxide*					
Nitrogen Sesquioxide: *See Nitrogen Trioxide*					

V-1 — 1987 TABLE 1 — ALPHABETICAL LIST OF GASES AND CONNECTIONS ASSIGNED (Cont'd.)

GAS			STANDARD		LIMITED STANDARD		ALTERNATE STANDARD
			EXISTING	ADDED IN 1987	EXISTING	ADDED IN 1987	OBSOLETE 1/1/92
Nitrogen Tetroxide: *See Nitrogen Dioxide*							
Nitrogen Trifluoride				330			679
Nitrogen Trioxide				660			755
Nitrosyl Chloride			330			660	
Nitrosyl Fluoride			330				
Nitrous Oxide (R744a)		Threaded	326				
		Yoke	910				
Nitryl Fluoride			330				
Octafluorocyclobutane (RC318)				660	165, 182		668
Octafluoropropane (R218)				660	165, 182		668
Oxirane: *See Ethylene Oxide*							
Oxygen	Up to 3000 psig	Threaded	540				
	(20 680 kPa)	Yoke	870				
	3001-4000 psig (20 690-27 580 kPa)			577			
	4001-5500 psig (27 590-37 900 kPa)			701			
	Cryogenic Liquid Withdrawal		440				
Oxygen Difluoride			679				
Ozone							755
Pentaborane				350			660, 750
Pentachlorofluoroethane				660	165, 182		668
Pentafluoroethane (R125)				660	165, 182		668
Pentafluoroethyl Iodide				660	165, 182		668
Pentafluoropropionitrile				660			750
Perchloryl Fluoride			670				
Perfluoroacetone: *See Hexafluoroacetone*							
Perfluorobutane				660	165, 182		668
Perfluoro-2-butene				660	165, 182		668
Perfluorocyclobutane: *See Octafluorocyclobutane*							
Perfluorodimethyl Peroxide: *See Hexafluorodimethyl Peroxide*							
Perfluoroethane: *See Hexafluoroethane*							
Perfluoropropane: *See Octafluoropropane*							
Phenylcarbylamine Chloride			330				
Phosgene				660		160	750
Phosphine			350			660	
Phosphorous Pentafluoride			330			660	
Phosphorous Trifluoride			330			660	

V-1 — 1987 TABLE 1 — ALPHABETICAL LIST OF GASES AND CONNECTIONS ASSIGNED (Cont'd.)

GAS		STANDARD		LIMITED STANDARD		ALTERNATE STANDARD
		EXISTING	ADDED IN 1987	EXISTING	ADDED IN 1987	OBSOLETE 1/1/92
Propadiene: *See Allene*						
Propane (R290)	*Gas Withdrawal*	510			600	
	Liquid Withdrawal	555				
Propene: See Propylene						
Propylene (R1270)		510			600	
Propyne: See Methylacetylene						
"REFRIGERANTS" — Numerical Listing						
R11: *See Trichlorofluoromethane*						
R12: *See Dichlorodifluoromethane*						
R12B1: *See Bromochlorodifluoromethane*						
R12B2: *See Dibromodifluoromethane*						
R13: *See Chlorotrifluoromethane*						
R13B1: *See Bromotrifluoromethane*						
R14: *See Tetrafluoromethane*						
R21: *See Dichlorofluoromethane*						
R22: *See Chlorodifluoromethane*						
~~R23: See Fluoroform~~						
R31: *See Chlorofluoromethane*						
R32: *See Methylene Fluoride*						
R40: *See Methyl Chloride*						
R41: *See Methyl Fluoride*						
R50: *See Methane*						
R112: *See 1,1,2,2-Tetrachlorodifluoroethane*						
R112a: *See 1,1,1,2-Tetrachlorodifluoroethane*						
R113: *See 1,1,2-Trichlorotrifluoroethane*						
R113B1: *See Bromotrifluoroethylene*						
R114: *See 1,2-Dichlorotetrafluoroethane*						
R114a: *See 1,1-Dichlorotetrafluoroethane*						
R114B2: *See 1,2-Dibromotetrafluoroethane*						
R115: *See Chloropentafluoroethane*						
R116: *See Hexafluoroethane*						
R123: *See 2,2-Dichloro-1,1,1-trifluoroethane*						
R124: *See 1,-Chloro-1,2,2,2-tetrafluoroethane*						
R125: *See Pentafluoroethane*						
R133a: *See 1-Chloro-2,2,2-trifluoroethane*						
R142b: *See 1-Chloro-1,1-difluoroethane*						
R143a: *See 1,1,1-Trifluoroethane*						
R152a: *See 1,1-Difluoroethane*						

V-1 — 1987 TABLE 1 — ALPHABETICAL LIST OF GASES AND CONNECTIONS ASSIGNED (Cont'd.)

GAS		STANDARD		LIMITED STANDARD		ALTERNATE STANDARD
		EXISTING	ADDED IN 1987	EXISTING	ADDED IN 1987	OBSOLETE 1/1/92
"REFRIGERANTS"—Numerical Listing (continued)						
R160: *See Ethyl Chloride*						
R170: *See Ethane*						
R218: *See Octafluoropropane*						
R290: *See Propane*						
RC316: *See Dichlorohexafluorocyclobutane*						
RC317: *See Chloroheptafluorocyclobutane*						
RC318: *See Octafluorocyclobutane*						
R600: *See Butane*						
R601: *See Isobutane*						
R630: *See Monomethylamine*						
R631: *See Monoethylamine*						
R717: *See Ammonia*						
R729: *See Air*						
R744: *See Carbon Dioxide*						
R744a: *See Nitrous Oxide*						
R764: *See Sulfur Dioxide*						
R1113: *See Chlorotrifluoroethylene*						
R1114: *See Tetrafluoroethylene*						
R1130: *See 1,2-Dichloroethylene*						
R1132a: *See 1,1-Difluoroethylene*						
R1140: *See Vinyl Chloride*						
R1141: *See Vinyl Fluoride*						
R1150: *See Ethylene*						
R1270: *See Propylene*						
Silane	Up to 500 psig (3 450 kPa)		510			
	Up to 3000 psig (20 680 kPa)	350				
Silicon Tetrafluoride		330				
Silicon Tetrahydride: *See Silane*						
Stibine		350				
Sulfur Dioxide (R764)			660			668
Sulfur Hexafluoride			590			668
Sulfur Tetrafluoride		330				
Sulfuryl Fluoride			660			330
1,1,1,2-Tetrachlorodifluoroethane (R112a)			660	165, 182		668
1,1,2,2-Tetrachlorodifluoroethane (R112)			660	165, 182		668

V-1 — 1987 TABLE 1 — ALPHABETICAL LIST OF GASES AND CONNECTIONS ASSIGNED (Cont'd.)

GAS	STANDARD		LIMITED STANDARD		ALTERNATE STANDARD
	EXISTING	ADDED IN 1987	EXISTING	ADDED IN 1987	OBSOLETE 1/1/92
1,1,2,2-Tetrafluoro-1-chloroethane		660	165, 182		668
Tetrafluoroethylene (R1114)	350		165, 182		
Tetrafluorohydrazine	679				
Tetrafluoromethane (R14)	580			320	
Tetrafluorosilane: *See Silicon Tetrafluoride*					
Tetramethyllead					750
Tetramethylmethane: *See 2,2-Dimethylpropane*					
Trichlorofluoromethane (R11)		660			668
Trichloromonofluoromethane: *See Trichlorofluoromethane*					
1,1,1-Trichlorotrifluoroethane		660	165, 182		668
1,1,2-Trichlorotrifluoroethane (R113)		660			668
Triethylaluminum		510			750
Triethylborane		660			750
Trifluoroacetonitrile		660			750
Trifluoroacetyl Chloride	330				
Trifluorobromomethane: *See Bromotrifluoromethane*					
Trifluorochloroethylene: *See Chlorotrifluoroethylene*					
1,1,1-Trifluoroethane (R143a)	510				
Trifluoroethylene	510				
Trifluoromethane: *See Fluoroform*					
Trifluoromethyl Chloride: *See Chlorotrifluoromethane*					
Trifluoromethyl Hypofluorite	679				
Trifluoromethyl Iodide		660	165, 182		668
Trifluorovinyl Bromide: *See Bromotrifluoroethylene*					
Trimethylamine	705				240
Trimethylene: *See Cyclopropane*					
Trimethylmethane: *See Isobutane*					
Trimethylstibine					750
Tungsten Hexafluoride		670			330
Uranium Hexafluoride	330				
Vinyl Bromide	510			290	
Vinyl Chloride (R1140)	510			290	
Vinyl Fluoride (R1141)	350				

V-1 — 1987 TABLE 1 — ALPHABETICAL LIST OF GASES AND CONNECTIONS ASSIGNED (Cont'd.)

GAS		STANDARD		LIMITED STANDARD		ALTERNATE STANDARD
		EXISTING	ADDED IN 1987	EXISTING	ADDED IN 1987	OBSOLETE 1/1/92
Vinylidene Fluoride: *See 1,1-Difluoroethylene*						
Vinyl Methyl Ether		510			290	
Xenon	Up to 3000 psig (20 680 kPa)	580				
	3001-5500 psig (20 690-37 900 kPa)		680			677
	5501-7500 psig (38 000-51 700 kPa)		677			

V-1 — 1987 TABLE 2
ALPHABETICAL LIST OF MEDICAL GAS MIXTURES①② AND CONNECTIONS ASSIGNED

GAS		STANDARD		LIMITED STANDARD		ALTERNATE STANDARD
		EXISTING	ADDED IN 1987	EXISTING	ADDED IN 1987	OBSOLETE 1/1/92
Medical Gas Mixtures for pressures up to 3000 psig:						
Carbon Dioxide & Oxygen (CO_2 not over 7%)	Threaded	280				
	Yoke	880				
Carbon Dioxide & Oxygen (CO_2 over 7%)	Threaded	500				
	Yoke	940				
Carbon Dioxide, Oxygen, Nitrogen	Threaded		500			
	Yoke		973			
Clinical Blood Gas Mixtures	Threaded		500			
	Yoke		973			
Gas Mixtures, Medical①③ Nonflammable, Noncorrosive	Threaded	500				
	Yoke		973			
Helium & Oxygen (He not over 80%)	Threaded	280				
	Yoke	890				
Helium & Oxygen (He over 80%)	Threaded	500				
	Yoke	930				
Lung Diffusion Mixtures	Threaded		500			
	Yoke		973			
Nitrous Oxide & Oxygen (N_2O 47.5 to 52.5%)	Threaded	280				
	Yoke	965				
Nitrogen & Oxygen (O_2 over 23.5%)	Threaded	280				
	Yoke		890			
Xenon & Oxygen (O_2 over 20%)	Threaded		280			
	Yoke		890			

① For a definition of the term Medical Gas see paragraph 6 page 11 of the Introduction.
② Nominal mixture concentration; normal mixture tolerances are allowable.
③ Gas mixtures labeled as drugs or medical devices and not having another connection assignment.

APPENDIX N

INTRODUCTION TO TABLES

REQUIRED PRESSURE RELIEF DEVICES

The types of pressure relief devices listed in Table 1 are acceptable as indicated in Table 3 by a letter symbol or symbols for application on cylinders for various compressed gases and gas mixtures. In the event that a fire test is required, it shall be performed in accordance with CGA C-12, *Qualification Procedure for Acetylene Cylinder Design*, and CGA C-14, *Procedures for Fire Testing of DOT Cylinder Safety Relief Device Systems*. A fire test shall be conducted when the flow capacity of a pressure relief device is sized less than required by formula in this standard.

Requests for types and applications of pressure relief devices other than those listed in Table 1 or Table 3 must be sent to the Compressed Gas Association, Inc. for assignment and be accompanied by test data as shown on a form as suggested in Appendix A.

TABLE 1

TYPES OF PRESSURE RELIEF DEVICES

CG-1	Rupture Disk
CG-2	165°F (73.9°C) Fusible Plug ≤ 500 psi - service pressure
CG-3	212°F (100°C) Fusible Plug ≤ 500 psi - service pressure.
CG-4	Rupture Disk with 165°F (73.9°C) Fusible Alloy Backing
CG-5	Rupture Disk with 212°F (100°C) Fusible Alloy Backing
CG-7	Pressure Relief Valve

CG9 Fusible Plug > 500 p.s.i & not > 6000 psi

TABLE 3

ALPHABETICAL LIST OF GASES AND DEVICES ASSIGNED (see notes)

Note 1: When more than one type of device is listed in Table 3 for a particular gas, only one type is required.

Note 2: The symbols used in Table 3 are defined at the end of the table. Interpretation of these symbols is necessary to determine the type of relief device to be used with the specific lading.

Note 3: Type CG-4 and CG-5 devices are not acceptable for 110% fill: see 49 CFR 173.302(c).

Note 4: For certain gases, use of pressure relief devices is not permitted. For such gases the pressure relief device column is marked "Prohibited."

CRYOGENIC LIQUIDS

FTSC Code	Name of Gas	CG-1 Disk	CG-2 165°F	CG-3 212°F	CG-4 165°F w/Disk	CG-5 212°F w/Disk	CG-7 RV
	Argon	G					
	Helium	G					
	Hydrogen	G					
	Neon	G					
	Nitrogen	G					
	Oxygen	G					

GASES

FTSC Code	Name of Gas	CG-1 Disk	CG-2 165°F	CG-3 212°F	CG-4 165°F w/Disk	CG-5 212°F w/Disk	CG-7 RV
5130	Acetylene			F			
1160	Air	A		KB	B	B	K
2100	Allene		M				A
	Allylene (See Methylacetylene)						
0202	Ammonia, Anhydrous (Over 165 lb) (None required if under 165 lb)		E				
0303	Antimony Pentafluoride	Prohibited					
0160	Argon	A			B	B	K
2500	Arsine	Prohibited					
0503	Arsenic Pentafluoride	Prohibited					
	Boron Chloride (See Boron Trichloride)						
	Boron Fluoride (See Boron Trifluoride)						
0203	*Boron Trichloride		L				
0263	Boron Trifluoride				B	B	
4303	*Bromine Pentafluoride	Prohibited					
4303	*Bromine Trifluoride	Prohibited					
0403	*Bromoacetone	Prohibited					
0100	*Bromochlorodifluoromethane (R12B1) or (Halon 1211)	L					L
0100	*Bromochloromethane (Halon 1011)	None Required					

*Not a Compressed Gas.

TABLE 3

ALPHABETICAL LIST OF GASES AND DEVICES ASSIGNED (Continued)

FTSC Code	Name of Gas	CG-1 Disk	CG-2 165°F	CG-3 212°F	CG-4 165°F w/Disk	CG-5 212°F w/Disk	CG-7 RV
	Bromoethylene (See Vinyl Bromide)						
	Bromomethane (See Methyl Bromide)						
3100	Bromotrifluoroethylene (R113B1)	C					A
0100	Bromotrifluoromethane (R13B1 or Halon 1301)	A					A
5100	1.3 Butadiene. (Inhibited)						A
2100	Butane. Normal			M			A
2100	1-Butene						A
2100	2-Butene						A
0110	Carbon Dioxide	A					K
	Carbon Dioxide/Nitrous Oxide Mixture (Liquid)	A					
	Carbon Dioxide/Oxygen Mixture (Gas)	A			B	B	K
	Carbonic Acid (See Carbon Dioxide)						
2260	Carbon Monoxide				J	J	
	Carbon Oxysulfide (See Carbonyl Sulfide)						
	Carbon Tetrafluoride (See Tetrafluoromethane)						
	Carbonyl Chloride (See Phosgene)						
0413	Carbonyl Fluoride	Prohibited					
2301	Carbonyl Sulfide		B		BC		
4203	Chlorine (See Par. 6.2.4)		H				
4303	Chlorine Pentafluoride	Prohibited					
4303	Chlorine Trifluoride	Prohibited					
2100	Chlorodifluoroethane (R142b)		M	M			A
0100	Chlorodifluoromethane (R22)	A	M	M			A
0100	Chlorodifluoromethane/ Chloropentafluoroethane (Mixture) (R502)	A	M	M			A
	Chloroethane (See Ethyl Chloride)						
	Chloroethylene (See Vinyl Chloride)						
2100	Chlorofluoromethane (R31)						A
0100	Chloroheptafluorocyclobutane (RC317)	A					A
	Chloromethane (See Methyl Chloride)						
0100	Chloropentafluorethane (R115)	A					A
0100	1-Chloro-1.2.2.2-Tetrafluoroethane (R124)	A					A
0100	1-Chloro-2.2.2-Trifluoroethane (R133a)	A					A
5200	Chlorotrifluoroethylene (R1113)	C					A
0100	Chlorotrifluoromethane (R13)	A			P		
2400	Cyanogen	Prohibited					
0403	Cyanogen Chloride	Prohibited					
2100	Cyclobutane		M				A
2100	Cyclopropane	A	M				A
2160	Deuterium	N			J	J	

*Not a Compressed Gas.

TABLE 3

ALPHABETICAL LIST OF GASES AND DEVICES ASSIGNED (Continued)

FTSC Code	Name of Gas	CG-1 Disk	CG-2 165°F	CG-3 212°F	CG-4 165°F w/Disk	CG-5 212°F w/Disk	CG-7 RV
0213	Deuterium Chloride				B		
0203	*Deuterium Fluoride	None Required					
2500	Deuterium Selenide	Prohibited					
2301	Deuterium Sulfide		B		BC		
5360	Diborane				B	B	
1200	*Dibromodifluoroethane	None Required					
0200	*Dibromodifluoromethane (R12B2) (Halon 1202)	None Required					
	Dibromomethane (See Methylene Bromide)						
0100	*1.2 Dibromotetrafluoroethane (R114B2) (Halon 2402)	L					L
0100	*1.2 Dichlorodifluoroethylene	None Required					
0100	Dichlorodifluoromethane (R12)	A	M	M			A
0100	Dichlorodifluoromethane/Difluoroethane Mixture (R500)	A	M	M			A
0200	*1.2 Dichloroethylene (R1130)	None Required					
0100	*Dichlorofluoromethane (R21)	L					L
0100	*1.2 Dichlorohexafluorocyclobutane (RC316)	None Required					
2403	*Dichlorosilane	Prohibited					
0100	*1.1 Dichlorotetrafluoroethane (R114a)	L	M	M			L
0100	*Dichlorotetrafluoroethane (R114)	L	M	M			L
0100	*2.2 Dichloro-1.1.1-Trifluoroethane (R123)	None Required					
	Dicyan (See Cyanogen)						
3300	*Diethylzinc	Prohibited					
2100	1.1 Difluoroethane (R152a)		M	M			A
2110	1.1 Difluoroethylene (R1132a)	A			B		
	Difluoromethane (See Methylene Fluoride)						
2202	*Dimethylamine, Anhydrous	None Required					
2100	Dimethyl Ether						A
3200	*Dimethylsilane	None Required					
2100	*2.2 Dimethylpropane						L
0403	Diphosgene	Prohibited					
2110	Ethane	J					
2100	*Ethylacetylene		L				L
2100	*Ethyl Chloride		L				L
0403	Ethyldichloroarsine	Prohibited					
2160	Ethylene	J					
5320	*Ethylene Oxide	(See 49 CFR 173.124)					
2100	*Ethyl Ether						L
2400	Ethyl Fluoride	Prohibited					
4343	Fluorine	Prohibited					

*Not a Compressed Gas.

TABLE 3

ALPHABETICAL LIST OF GASES AND DEVICES ASSIGNED (Continued)

FTSC Code	Name of Gas	CG-1 Disk	CG-2 165°F	CG-3 212°F	CG-4 165°F w/Disk	CG-5 212°F w/Disk	CG-7 RV
	Fluoroform (R23) (See Trifluoromethane)						
2400	Germane	Prohibited					
0160	Helium	A			B	B	K
	Helium/Oxygen Mixture	A			B	B	K
2400	Heptafluorobutyronitrile	Prohibited					
0203	Hexafluoroacetone		B		B		
2400	Hexafluorocyclobutene	Prohibited					
0100	Hexafluoroethane (R116)	A			B		
0100	Hexafluoropropylene (R1216)	A					A
2160	Hydrogen	N			J	J	K
0203	Hydrogen Bromide				E		
0313	Hydrogen Chloride				B		
5301	Hydrogen Cyanide	Prohibited					
0203	*Hydrogen Fluoride	None Required					
0203	Hydrogen Iodide				B		
2500	Hydrogen Selenide	Prohibited					
2301	Hydrogen Sulfide		B		BC		
4303	*Iodine Pentafluoride	Prohibited					
2100	Isobutane						A
2100	Isobutylene						A
0160	Krypton	A			B	B	K
0403	Lewisite	Prohibited					
2160	Methane	N			J	J	K
2100	Methylacetylene		M				A
0300	*Methyl Bromide	None Required					
2100	*3-Methyl-1-Butene						L
2200	Methyl Chloride						A
0403	Methyldichloroarsine	Prohibited					
2203	*Methylene Bromide	None Required					
2203	Methyl Fluoride				B		
0110	Methylene Fluoride (R32)	A					A
2200	*Methyl Formate	None Required					
0303	*Methyl Iodide	None Required					
2201	Methyl Mercaptan	None Required					
3200	*Methylsilane	None Required					
2202	*Monoethylamine	None Required					
2202	Monomethylamine, Anhydrous	None Required					
0403	Mustard Gas	Prohibited					
2160	Natural Gas	N			J	J	K
0160	Neon	A			B	B	K

*Not a Compressed Gas.

TABLE 3

ALPHABETICAL LIST OF GASES AND DEVICES ASSIGNED (Continued)

FTSC Code	Name of Gas	CG-1 Disk	CG-2 165°F	CG-3 212°F	CG-4 165°F w/Disk	CG-5 212°F w/Disk	CG-7 RV
2400	*Nickel Carbonyl	Prohibited					
4461	Nitric Oxide	Prohibited					
0160	Nitrogen	A		KB	B	B	K
4401	*Nitrogen Dioxide	Prohibited					
4401	*Nitrogen Tetroxide	Prohibited					
4343	Nitrogen Trifluoride			B	B	B	
4301	Nitrogen Trioxide	Prohibited					
0203	Nitrosyl Chloride	None Required—10 lb weight and under					
0303	Nitrosyl Fluoride	Prohibited					
4110	Nitrous Oxide	A					
0303	Nitryl Fluoride	Prohibited					
0100	Octafluorocyclobutane (RC318)						A
0100	Octafluoropropane (R218)	A					A
4160	Oxygen	A			B	B	K
~~4343~~	~~Oxygen Difluoride~~	Prohibited					
4330	Ozone (Dissolved in R13)	Prohibited					
3300	*Pentaborane	Prohibited					
2400	Pentafluoropropionitrile	Prohibited					
4303	Perchloryl Fluoride	Prohibited					
0100	*Perfluorobutane		L				L
0200	*Perfluoro-2-Butene						L
0303	Phenylcarbylamine Chloride	Prohibited					
0403	Phosgene	Prohibited					
3510	Phosphine	Prohibited					
0403	Phosphorous Pentafluoride	Prohibited					
0203	Phosphorous Trifluoride				B		
2100	Propane			M			A
2100	Propylene						A
3360	Silane				B		
0203	*Silicon Tetrachloride	None Required					
0263	Silicon Tetrafluoride				B		
5300	Stibine	Prohibited					
0201	Sulfur Dioxide		B				
0100	Sulfur Hexafluoride	A				B	A
0203	Sulfur Tetrafluoride				B		
0300	Sulfuryl Fluoride		B				
5110	Tetrafluoroethylene-Inhibited (R1114)	A			B		
4343	Tetrafluorohydrazine	Prohibited					
0160	Tetrafluoromethane (R14)	A			B	B	K
2400	Tetramethyllead	Prohibited					

*Not a Compressed Gas.

TABLE 3

ALPHABETICAL LIST OF GASES AND DEVICES ASSIGNED (Continued)

FTSC Code	Name of Gas	CG-1 Disk	CG-2 165°F	CG-3 212°F	CG-4 165°F w/Disk	CG-5 212°F w/Disk	CG-7 RV
0100	*Trichlorofluoromethane (R11)	L					L
2203	*Trichlorosilane	None Required					
0100	*1.1.1 Trichlorotrifluoroethane (R113a)	None Required					
0100	*1.1.2 Trichlorotrifluoroethane (R113)	None Required					
3300	Triethylaluminum	Prohibited					
3300	Triethylborane	Prohibited					
2400	Trifluoroacetonitrile	Prohibited					
0303	Trifluoroacetyl Chloride	Prohibited					
2100	1.1.1 Trifluoroethane (R143a)		M				A
0100	Trifluoromethane (R23)	A			E		
4363	Trifluoromethyl Hypofluorite	Prohibited					
0200	Trifluoromethyl Iodide				B		
2202	*Trimethylamine	None Required					
3200	*Trimethylsilane	None Required					
3300	Trimethylstibine	Prohibited					
0303	*Tungsten Hexafluoride	Prohibited					
0303	*Uranium Hexafluoride	Prohibited					
5200	*Vinyl Bromide		L				L
5200	Vinyl Chloride		E				A
2100	Vinyl Fluoride				B		
5200	Vinyl Methyl Ether		E				A
0160	Xenon	A			B		K

*Not a Compressed Gas.

Definitions of Symbols Used in Table 3

A. This device is required in one end of the cylinder only, regardless of length, with the exception of trailer tubes in which this device is required in both ends.

B. When cylinders are over 65 inches (1651 mm) long, exclusive of the neck, this device is required at both ends. For shorter cylinders, the device is required in one end only.

C. This device is permitted only in cylinders having a minimum required test pressure of 3000 psig (20 680 kPa) or higher, and is required in one end only. The bursting pressure of the disk shall be at least 75% of the minimum required test pressure of the cylinder.

D. [Reserved]

E. When cylinders are over 30 inches (762 mm) long, exclusive of the neck, this device is required at both ends. For shorter cylinders, the device is required in one end only.

F. The number and location of pressure relief devices for cylinders of any particular size shall be proved adequate as a result of the fire test. Any change in style of cylinder, a filler, or quantity of devices can only be approved if found adequate upon reapplication of the fire test. The fire test shall be conducted in accordance with CGA C-12, *Qualification Procedure for Acetylene Cylinder Design.* [8]

APPENDIX O
WORKS CITED

WORKS CITED

Code of Federal Regulations (49CFR): Transportation: Parts 100 to 177 Revised as of December 31, 1991

Compressed Gas Association. C-6: Standards for Visual Inspection of Steel Compressed Gas Cylinders. Virginia, 1984.

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Emergency Technical Services Corp. Cylinder Management and Safety Awareness Training. Schaumberg, IL, 1993.

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CHICAGO PLANT CHECKLIST

GENERATOR:

DRUM #:

____ Confirm cylinder is not leaking with leak test?

____ Confirm cylinder is not dented?

____ Confirm cylinder does not have corrosion?

____ Confirm cylinder is not bulging?

____ Confirm cylinder has CEF attached?

____ Confirm cylinder is properly labeld?

____ Confirm color coding if cylinder is Matheson or Medical gas?

____ Confirm CGA outlet for gas type?

____ Confirm pressure rating for gas type?

____ Confirm proper type of relief device?